

## **Towards an enactivist methodology for analysing a large video data set**

Alistair Bissell

*University of Bristol*

This article begins to outline a methodology for working with a large video data set, in line with an enactivist theoretical stance. Between 2020 and 2022 I ran 5 cohorts of an online course, using Zoom, aimed at supporting teachers of A level Maths to develop their pedagogy. I have recorded around 70 hours of video and Zoom has transcribed the audio. I share some representations of data created in R, a programming language for statistical computing and graphics, showing how these could be used to select sections of video for further, more detailed, analysis.

**Keywords: enactivism; online professional development; video; methodology**

### **Introduction**

This article considers the challenge of analysing a large video data set in line with an enactivist research perspective, in the context of my research into the online professional development (PD) of teachers of mathematics. Online courses are convenient and accessible to teachers, but sustaining engagement and facilitating interaction are a challenge of remote learning (Walker et al., 2022, p. 48).

### **Context**

Having been a facilitator of in-person PD for teachers of A level Maths for several years, the Covid-19 pandemic required me to instead run PD courses online, using Zoom. When leading professional development, I aim to work with the teachers in front of me and what they bring with them. I do not believe in one ‘best’ way to teach mathematics; rather that there are many ways to teach effectively, and often what makes a teacher effective is that they have conviction in the classroom that they are trying to create with their learners.

The shift to running PD online brought with it many challenges. How could I work with the teachers in front of me, and their classrooms, when in an online environment? In order to work with what the teachers brought, I needed them to contribute to my sessions such that I could respond to these contributions. I was advised to keep things simple while I got used to working online, but chose to ignore this advice in favour of trying to get participants to contribute in as many ways as possible from the very first session. Participants had their videos on, annotated the screen, typed contributions into the chat, spoke verbally into the session, went into breakout rooms and used a Desmos activity. My experience of classrooms taught me that first sessions with new groups are important for establishing ways of working so, if teachers experienced engaging actively throughout the first session of the course, they would come to the second expecting to engage again.

To build upon this experience I planned, in the final session of the course, to refer back to teachers’ experience of this first session in order to provoke teachers to

consider how they might, in their first lesson with a new A level Maths group, get students acting in the ways they wanted in their classrooms.

The course was designed to support teachers new to teaching A level Maths to develop their pedagogy. Initially, the course consisted of 10 online sessions, run in Zoom, of 75 minutes each, but later this became 8 sessions, each with a pedagogical theme and a mathematical context.

### ***Research questions and data***

My data consists of 46 video recordings (approximately 90 minutes each, including participants arriving early and waiting behind after sessions) of online sessions from 5 cohorts. My research questions are:

1. What are my practices as facilitator of an online mathematics teacher professional development course?
2. What contributions do teachers make to the online course and what distinctions does the facilitator make in response?
3. How do ways of working get established in an online maths teacher professional development course?

Engaging with these questions will require a detailed look at short sections of video. The focus of the rest of this article is on how I can select these short sections for further analysis, without having to watch back all 70 hours of video. I will begin by introducing an enactivist theoretical stance before considering the methodological implications for analysing a large video data set. I will describe how I used R, a programming language for statistical computing, to analyse and represent my audio transcripts, in order to select short sections of video for further analysis.

### **Enactivism**

Enactivism was first conceived by Varela, Thompson and Rosch (1991) with the intention of bringing closer together the seemingly distinct approaches to understanding the mind of cognitive science and phenomenology. While cognitive science aims to be rigorous in making objective observations of ‘reality’ and testing models and hypotheses with unbiased experiments, phenomenology is the study of notions that cannot be observed or measured but that we all experience directly and are often important to us, such as love, anger or pain. “The fundamental insight of the enactive approach... is to be able to see our activities as reflections of a structure without losing sight of the directness of our own experience” (Varela, Thompson and Rosch, 1991, p.12). This allows us to take seriously phenomenological notions of *experience* as intertwined with our actions on and within an environment.

Enactivism denies that cognition is an internal, mental representation of an external reality, instead proposing that cognition is “the enactment of a world and a mind on the basis of a history of the variety of actions that a being in the world performs” (Varela, Thompson and Rosch, 1991, p.9). Enactivism distances itself from models of cognition where the mind is primarily like a computer that processes inputted information and represents it mentally before processing an output. Instead, responses are said to be “structurally determined” (Maturana and Varela, 1992, p.96); that is the structure of the creature is what determines its response to a stimulus, not the stimulus itself. A creature’s structure will be partially determined by its history of experiences, but not because it has *remembered* these experiences. Rather, a

creature's structure is plastic in nature; that is, a creature's structure is changed and created by its experiences. So, a creature may respond differently when it experiences something for the second time not because it has remembered the experience and that it should react differently, but because its structure has changed in response to the first experience (or others). It is now a different creature (or you could say it has learned).

From an enactivist perspective, perception and action are interdependent and inseparable; we perceive our world through acting in and upon it, and we act in our world based on how we perceive it. This means that our environment, body and mind are also one interdependent system. Our mind experiences our world through our body acting upon and perceiving its environment.

A feature of enactivism that helps to explain interaction between creatures and their environments, and creatures and other creatures, is that of "structural coupling" (Reid & Mgombelo, 2015, p.174), where one creature might perform an action which is sensed by another creature, which in turn performs an action according to its structure. The creatures can be thought of as structurally coupled when "there are recurrent patterns of triggering and being triggered that result in structures that allow these patterns to persist." (Reid & Mgombelo, 2015, p.174-5)

### **Communication and ritualisation**

Despite being inseparable, Varela, Thompson and Rosch (1991, p.24) claim that "body and mind are seldom closely coordinated", meaning that many of our actions are habitual and seemingly automatic, even when carrying out quite complex tasks. For example, our (conscious) minds can be thinking about other things while we are driving. Bateson (1972, p.143) claims that "no organism can afford to be conscious of matters with which it could deal at unconscious levels". We are not able to process the huge amounts of information entering our senses, represent this information in our minds and then process the potential responses in order to act. In order for us to act quickly and effectively in complex situations, much of what we know and do must be habitual and subconscious.

Sfard and Lavie (2005, p.237) claim that the activity of communicating begins with ritualized participation that leads to development in being able to see as "the same" things that, so far, could only be seen as different. Rituals are social "acts of solidarity with those with whom they are performed" (Sfard and Lavie, 2005, p.272) and as such are performed habitually and recurrently corrected. From an enactivist perspective, these rituals serve to develop a structural coupling between those in communication.

Coles and Sinclair (2019, p.177) argue that ritual can be more than merely unthinking performance and needs to simultaneously be a form of doing and thinking if new thinking is to emerge. Drawing upon Bell (1991, p.93), Coles and Sinclair (p.181) claim that ritualisation as a form of thinking does "not bring what is being done across the threshold of discourse or systematic thinking". When communicating, the patterns of interaction can be symbolic and as meaningful as the (literal) meaning of the words. When talking, we often do not know what words we are going to say until we begin saying them. When listening, it is our sense of what we expect to hear that allows us to hear what we expect. In conversation, it is likely that meanings of words are interpreted differently by speaker and listener, but that subsequent turns tend to correct for these differences and a shared meaning begins to emerge.

Bateson (2002, p.14) claims that "without context, words and actions have no meaning at all". This helps to justify the study of language and communication not

solely through the literal meanings of the words, but through the patterns of interaction and rituals taking place, which provide the context that allows for the words to be meaningful.

### Methodological implications for analysing transcript data

“We can never be quite clear whether we are referring to the world as it is or to the world as we see it.” (Ruesch & Bateson, 2006, p.238) From an enactivist perspective, what we perceive is based upon our past experiences of the world, which make us what we are. But if we see things not as they are, but as we are, then how might it be possible to see in *new* ways?

One explanation for us perceiving the world based on our history of experiences is that this allows us to quickly evaluate complex situations in order to act habitually and automatically. If we want to see more of our environment (in this case the transcript) then we need to find ways to avoid premature evaluation of what we are seeing, which often involves being disciplined about focusing on the detail of small and manageable sections of data (see, for example, Mason’s (2002) ‘Discipline of Noticing’). This, in turn, requires methods for selecting small and manageable sections of data from a larger data set. Coles (2015, p.239) proposes five mechanisms that allow an approach for analysing talk and language in mathematics classrooms, in line with an enactive view. In the following section I will demonstrate how the first two of these (recursive enquiry and the systematic search for pattern) fit well with the approach of programming in R in order to select sections of data for further analysis.

### Using R to analyse and represent data

R can be used to convert text data, from Zoom, into a format viewable in a spreadsheet, which can be interrogated more efficiently, as shown below:

```
WEBVTT
1
00:00:25.140 --> 00:00:25.590
Alistair Bissell: Welcome
2
00:00:28.290 --> 00:00:28.770
TA: Welcome
3
00:00:29.550 --> 00:00:33.330
Alistair Bissell: And can I ask what your name is so your first name.
```

Fig. 1: WebVTT format of transcription as provided by Zoom

	A	B	C	D	E	F	G	H	I	J	K	L
1	n	start	end	name	text	min	duration	words	fac/part	n_2	n_3	n_4
2	1	25.145	25.595	Alistair Bis	Welcome	0	0.45	1	F	F	F	F
3	2	28.295	28.775	TA	Welcome	0	0.48	1	P	PF	PF	PF
4	3	29.555	33.335	Alistair Bis	And can I ask what your name is so your first name.	0	3.78	13	F	FP	FPF	FPF
5	4	33.785	36.275	TA	Is Mr TA that on the.	0	2.49	6	P	PF	PPF	PPFF
6	5	36.965	41.735	Alistair Bis	yeah that'd be great because then people, we have to know how tc	0	4.77	24	F	FP	FPF	FPFF

Fig. 2: CSV format of transcription converted from WebVTT format by R

### The systematic search for pattern

In order to analyse 70 hours of transcript, it is helpful to use an automated approach, which can also fit well a “systematic search for pattern”, as described by Coles (2015, p.239):

To make the search for pattern systematic, decisions need to be made in advance. Having identified sections of the data to be the focus for analysis, the enactive view of language implies then looking for observable similarities or differences.

This stage of analysis may involve some quantitative methods, for example, word or phrase counts to identify commonalities.

Given that rituals in communication may not cross the threshold of discourse or systematic thinking, it may be difficult to notice patterns that could potentially contain meaning. By programming in R, decisions are made in advance such that all 70 hours can be considered in a way that avoids premature evaluation, instead being systematic in offering different representations of the 70 hours of transcript.

I initially programmed R to count participant and facilitator contributions throughout sessions of a course, which already involved making decisions, such as over what time period should I count and what constitutes a ‘contribution’?:

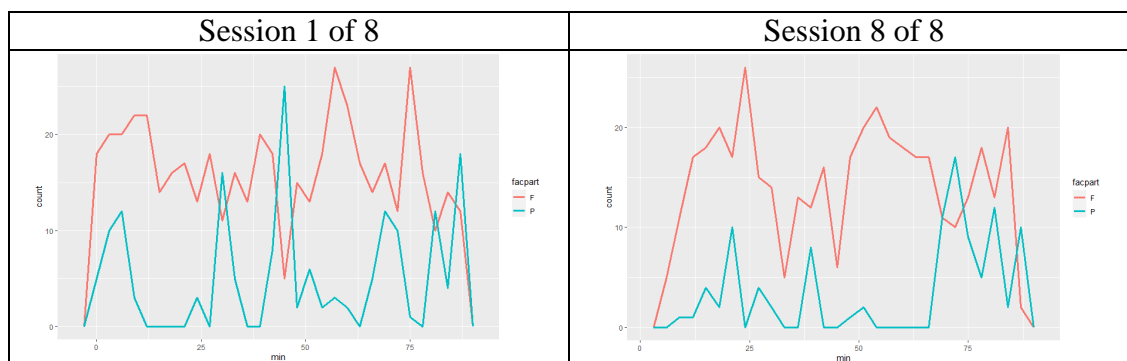


Fig. 3: Graphs to show Facilitator and Participant contributions over time for sessions 1 of 8 and 8 of 8

### *Recursive enquiry*

What is hidden in these initial graphs is that some contributions in session 1 were very short, which led me to want to ‘look’ for more substantial contributions. It seems that when quantitative observations are considered in the context of the situation that the criteria need to be refined and new questions are raised. Coles (2015, p.239) describes ‘recursive enquiry’ as “repeated interaction, with results from one iteration feeding into the next”.

R is well-suited to recursive enquiry because it is flexible in how it can be programmed to process and represent the data, such that data can be revisited and re-represented such that different patterns might be easily identified. I could program R to count and plot the number of words used, or the durations of contributions. I chose to look at patterns of interactions between Facilitator (F) and Participants (P). How many FFP, FPF, FPP, PFF, PFP, PPF, PPP contributions were there?

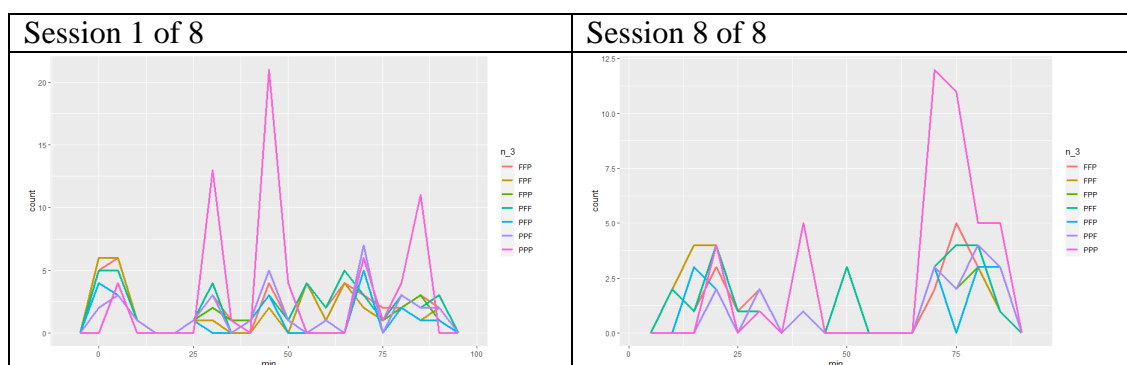


Fig. 4: Graphs to show Facilitator and Participant patterns of contribution over time ( $n=3$ )

There appears to be some structure to the patterns of interaction in these sessions and the PPP spikes look like worthwhile sections to analyse further. It is

worth noting, however, that they may not represent my pre-conceived sense of the notion of interaction. That said, it could be that they seem to have some other commonality that I am as yet unaware of. This feels particularly valuable from an enactivist perspective, given the difficulties of seeing in new ways.

## Conclusion

One clear advantage of using R to analyse transcript is how quickly it can process and represent that whole data set. I have demonstrated that programming in R can support “recursive enquiry” and “the systematic search for pattern”, two of Coles’ (2015, p.239) mechanisms for analysing classroom talk in line with an enactivist view.

From an enactivist perspective, a systematic approach to analysis, which is afforded by programming in R, is essential for allowing the possibility of seeing in new and different ways. However, this is to be balanced with drawing upon experience to inform how R is programmed, to increase the likelihood of richness, interest and informing research questions. While programming in R can provide a systematic and efficient approach to selecting which sections of video to analyse in more detail, it is the recursive nature of quantitative and qualitative approaches to analysis that allows meaning to emerge.

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