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Using Video and Multimodal Classroom Interaction Analysis to Investigate How Information, Misinformation, and Disinformation Influence Pedagogy

Profiling Emerging Research Innovations

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Abstract

Misinformation is accidentally wrong and disinformation is deliberately incorrect (i.e., deception). This article uses the Pedagogy Analysis Framework (PAF) to investigate how information, misinformation, and disinformation influence classroom pedagogy. 95 people participated (i.e., one lesson with 7-year-olds, another with 10-year-olds, and three with a class of 13-year-olds). The authors used four video-based methods (lesson video analysis, teacher verbal protocols, pupil group verbal protocols, and teacher interviews). 35 hours of video data (recorded 2013–2020) were analysed using Grounded Theory Methods by the researchers, the class teachers, and groups of pupils (three girls and three boys). The methodology was Straussian Grounded Theory. The authors present how often participants used information, misinformation, and disinformation. They illustrate how the PAF helps understand and explain information, misinformation, and disinformation in the classroom by analysing video data transcripts. In addition, the authors discuss participant perceptions of the status of information; overlapping information, misinformation, and disinformation; and information communication difficulties.

Keywords

emerging research innovations – video-based – pedagogy analysis – grounded theory – disinformation



FEATURE This article comprises multiple videos, which can be viewed [here](#).

1 Introduction

The ultimate end teachers generally seek is to help learners learn. These learning interactions happen in diverse learning environments (e.g., classroom, corridors, outdoors, ...) full of stuff that can influence the interactions like exercise books, chairs, trees, or whatever. The interactions are multimodal in that information is communicated between participants in a variety of ways (e.g., through speech, writing, mark making, gesture, facial expression, movement of objects, etc.; Kress, 2010). Prior learning can involve knowledge construction from information, but how are learning interactions affected if the information is wrong? Misinformation is accidentally wrong, and disinformation is deliberately wrong, but as we shall see, participants may not agree about these classifications (e.g., misinformation about information) and this also can influence interactions. The purpose of this exploratory article is to show how video-based methods and Multimodal Classroom Interaction Analysis (Kress, 2010) can help untangle the influences of information, misinformation, and disinformation in a learning environment like a classroom. Building on previous work (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021) we continue to take a Straussian Ground Theory approach in this article and present a set of theories to help teachers, teacher educators, and pedagogy researchers analyse interactions between people (e.g., learner and teacher, learner and imaginary friend, ...) and between people and things (e.g., learner and pencil, teacher and puppet, ...) where misinformation and/or disinformation is involved or potentially involved. So called “post truth” phenomena like misinformation and disinformation are of growing public concern according to Barzilai and Chinn (2020), have nevertheless always been part of human interaction, and raise pedagogical challenges for both pupils and their teachers according to Smith and Parker (2021). We present an analysis of video data of multimodal interactions involving misinformation and disinformation using the Pedagogy Analysis Framework which is a formal grounded theory which emerged from our previous studies. Data for this article came from two published studies that explored, from multiple perspectives, five school lessons (Riordan et al., 2021, investigated one primary science lesson and one primary Religious Education lesson, and Riordan, Hardman and Cumbers, 2021 examined three secondary school science lessons).

First, we discuss the nature of information, misinformation, and disinformation. Second, we explain the PAF. Third, we outline the research design. Fourth, we show how often participants misinform and disinform in the lessons studied, illustrate the use of the PAF with a thick description of

some incidents from the video data, and explain three additional findings regarding information, misinformation, and disinformation. Finally, we discuss originality, significance including the contribution of the PAF to the analysis of visual pedagogy, and limitations.

2 The Theoretical Approach

2.1 *What We Know*

2.1.1 What Is Information, and How Is It Related to Misinformation and Disinformation?

The concept ‘information’ is disputed (Stahl, 2006).

Philosophical work on the concept of (semantic) information is still at that lamentable stage when disagreement affects even the way in which the problems themselves are provisionally phrased and framed.

FLORIDI, 2015

Information is not a thing.

Information is the pattern of organization of matter and energy.

PARKER (1974, p. 10) quoted in BATES (2006, p. 1033)

Shannon (1993, p. 180) argued that no single definition of information will suffice. Hence Weaver (1949) suggested three meanings of ‘information’: technical problems concerned with information quantification, semantic problems about meaning and truth, and ‘influential problems’ concerning the impact of information on humans. We argue that pedagogy is influenced by both semantic and influential problems. An overview of the philosophy of information is beyond the scope of this article. We adopt the ‘General Definition of Information’ which says information consists of well-formed data that are meaningful. ‘Data’ is a lack of uniformity (the Diaphoric Definition of Data; Floridi, 2015). For example, blank paper contains no data, but when marked this is data as there is now a lack of uniformity.

“well-formed” means that the data are clustered together correctly, according to the rules (syntax) that govern the chosen system, code or language being analysed.

FLORIDI, 2015

Hence 'b' is information to me as this is 'well-formed' according to the English alphabet. Data can be well-formed, but not meaningful, as with a mark on paper which follows the syntax of an unknown foreign language. Similarly, data can be not well-formed and not meaningful, as with a meaningless squiggle.

Knowledge is constructed from information by participants:

Once information is available, knowledge can be built in terms of *justifiable* or *explainable semantic information*.

FLORIDI, 2015; original italics

According to De Jong and Ferguson-Hessler (1996) knowledge can be situational, conceptual, procedural, or strategic. How to classify knowledge is contested (e.g., Baroody et al., 2007). Misinformation (unintentionally untrue information) and disinformation (intentionally untrue information), like information, are disputed concepts (Fallis, 2015). Some argue misinformation and disinformation are separate categories (Hernon, 1995), whilst others including us see disinformation as a subset of misinformation (Fox, 1983). We think knowledge can be built on misinformation and/or disinformation. We understand deception as the use of disinformation.

The term *απάτη* [deception] originally means “leading away” and refers to the fact that a person is deflected from his own way of thought without realizing it.

MURRAY, 1988, p. 282

So, deception is “a distortion of perceived reality” (Whaley, 1982, p. 182), a type of misperception deliberately induced by another person. Two kinds of deception are possible according to Whaley (1982): dissimulation (hiding the real) and simulation (showing the false); both of which can be further subdivided. The three types of dissimulation are masking (make invisible), repackaging (disguise) and dazzling (cause someone to lose clear vision). Three types of simulation are mimicking (through imitation), inventing (display a different reality) and decoying (divert attention). We identified all these types of deception being used by participants (including teachers) in the classroom in previous studies (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021). Deception may not work.

[Deception is] a successful or unsuccessful deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue.

VRIJ, 2008, p. 15

In contrast, we argue that deception can be either with or without forewarning, and knowledge of another's deception is more nuanced than a simple binary may suggest. For example, in Riordan (2022) we discuss a case of teacher deception where the pupils clearly know they are being deceived (the teacher is pretending she does not know how to use a torch) yet happily play along with the subterfuge. Following Plato, we see lying (deliberate communication of an untruth with nefarious intent) as a subset of deception:

As a feature of [Plato's] rhetoric theory, deception is a technique without ethical implication. It is, so to speak, a leading away from one's opinion, not necessarily a leading away from the truth (though it may well be).

MURRAY, 1988, p. 282

Deception in university teaching and learning is explored by Smerick (2010) and Griffin, Bolkan and Goodboy (2015), and childhood deception was discussed by Salekin, Kubak and Lee (2008) and Taylor and Gozna (2011), but school classroom deception has not received much attention (with exceptions like Allen, 2019, who briefly describes 'bluff activities', and Riordan, 2015).

2.1.2 What Is the Pedagogy Analysis Framework (PAF)?

The Pedagogy Analysis Framework (PAF) is a formal grounded theory that emerged from three video-based studies which helps understand and explain pedagogy (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021). If substantive theory achieves 'theoretical saturation', a formal theory is possible which explains a phenomenon in a wider context (Glaser and Strauss, 1967, p. 31). The PAF is, we argue, a formal theory (see Riordan et al., 2021, for more on this). We understand pedagogy as the promotion of interactions between people (including the person with themselves), and between people and things, with the intention of bringing about learning (i.e., long-term changes in thinking, feeling, willing, and doing, which are not simply the result of human maturation; Illeris, 2007). We argue that misinformation and disinformation can influence pedagogical interactions between people in classrooms, and that misinformation and disinformation can also be used strategically by participants (e.g., learners and/or teachers). We first illustrate the use of the PAF with a simple imagined example of Ann successfully

deceiving Bob (i.e., an example of the pedagogical use of disinformation), explain the PAF in words and in Figure 1, and then explain how the PAF can be used to untangle this exemplar and other multimodal interactions involving misinformation and/or disinformation in classrooms. Elements of the PAF are shown in bold.

Ann is teaching a lesson about fruit in a classroom (i.e., a **context**) and has some **prior knowledge** (e.g., that Bob looks bored). Ann hides (i.e., uses disinformation, a **strategy**) an apple in an opaque bag (two **means**), and asks Bob, “What’s in the bag?” (another **strategy**), with the intention of motivating Bob to learn about fruit (an **end**). Getting pupils to identify hidden objects to motivate is a pedagogical strategy familiar to Ann (i.e., a known known where she wants to enact this ‘**solution**’). Bob guesses incorrectly (i.e., that it is a banana; he uses misinformation unconsciously, another **strategy**) but is no longer bored, so Ann’s plan has worked.

Next, we explain the PAF before illustrating it in Figure 1 below. In a context at a particular time any participant has prior knowledge_o. This participant might either know something (a known₂ known₁) or know that they do not know something (a known₄ unknown₃) often about a thing (‘intrapersonal’), themselves (intrapersonal) or another participant or participants (interpersonal). Any subsequent strategic intention and/or behaviour is

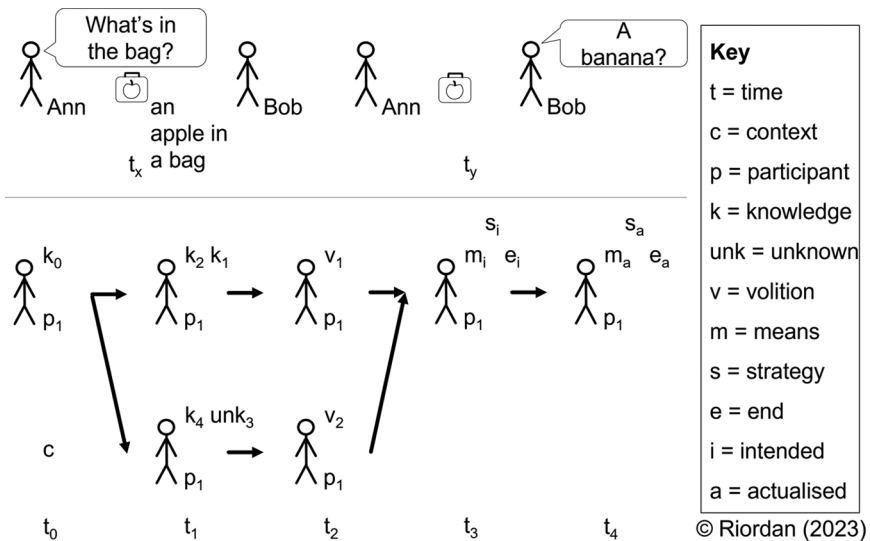


FIGURE 1 The Pedagogy Analysis Framework (PAF)
RIORDAN ET AL. (2021)

influenced to a greater or lesser extent (including sometimes causation) by the aforementioned knowledge context. If as a result this participant wishes (v_{1-2}) to do something, they plan to use various means_p, according to certain strategies_p, to try and achieve (and/or avoid) ends_p. Means can be the participant themselves, another participant (or group thereof), or a thing. Strategy is a spectrum concept from simple 'actions', through tactics, to grand strategies. Simple actions include speaking, gestures, movements, etc. Tactics are sequences of actions (usually involving established scripts) concerning one or more than one participant (and/or things). Grand strategies are complicated interactions requiring a thick description. All, some, or none of the intended plan might be actualised (means_a, strategies_a, and ends_a). This argument is illustrated in Figure 1 below. We term the preceding eleven elements of the PAF (i.e., $c, t, p, k_{0-4}, v_{1-2}, m_p, s_p, e_p, m_a, s_a, e_a$), as mentioned earlier, a 'Pedagogical Analysis Unit' (PAU). As participants interact with each other, and with things, PAUs can help understand and explain pedagogy. Intended and actualised ends can be regarding change initiation, intermediate steps, or final goals (such as learning). Grand strategy is the bigger picture of how elements within units and units themselves combine. A participant can be reacting to their own unit, or that of another participant. The knowledge that shapes each unit, and how units relate, is built by each participant from information, misinformation, and disinformation. As pedagogy is a continuous iterative process involving multiple participants, a unit gives an entry point for the pedagogy analyst.

2.2 *What We Do Not Know*

Participants in any school lesson, be they staff, pupil, or researcher, interact with each other (and with things) in contexts replete with misinformation and disinformation, but how accidental or deliberately wrong information influences pedagogy is unclear.

2.2.1 Research Questions

1. How do information, misinformation (accidentally wrong information), and disinformation (deliberately wrong information) influence the pedagogy of participants in a classroom as these people interact with each other and with things?
2. How can video-based methods and the Pedagogy Analysis Framework (PAF) help understand and explain the influences of information, misinformation, and disinformation on pedagogy?

This article has outlined our theoretical approach, including what we know, and what we do not, and now explains the research design.

3 Research Design

3.1 *The Theoretical Perspective and Epistemology*

In this article we use video-based methods and the PAF to understand and explain how misinformation and disinformation influence the pedagogy revealed in the data from the previous studies (i.e., Riordan, Hardman and Cumbers, 2021; and Riordan et al., 2021). Next, we give a brief overview of the Straussian Grounded Theory research design but for details please see the earlier articles.

3.2 *Data Collection and Analysis*

The four video-based research methods used were lesson analysis, teacher verbal protocols, pupil group verbal protocols, and researcher/teacher group interviews. Verbal protocols involve a participant, or participants, watching lesson video data and 'thinking aloud'. Such an approach can give rich data and access to how participants understand incidents (Leighton, 2017). Data for this present article were drawn from three lessons with 13-year-old pupils discussed in Riordan, Hardman and Cumbers (2021), and a lesson with 7-year-olds and another with 10-year-olds (both discussed in Riordan et al., 2021). Earlier work (Riordan, 2022) had many examples of misinformation and disinformation, but the research design was still developing, so this present article uses data from the more recent studies. Each lesson lasted approximately one hour and occurred as it would normally in the school year, the only changes being the presence of three video cameras (two at the front and one at the back of the room), microphones, and the attendance of one researcher. We encouraged the teachers to plan and teach as normal. Analysis began after the first lesson and continued after the end of data gathering. Delay between each lesson and the follow-up teacher and pupil group verbal protocol interviews allowed time for analysis and pupil group verbal protocol video clip preparation (see section 5.3 about 'limitations'). Video recorded teacher verbal protocols lasted about two hours for each lesson. Pupil group verbal protocols interviews lasted 30 minutes each. We used video clips from the relevant lesson in pupil group verbal protocol interviews for pragmatic reasons. We also video-recorded and analysed group teacher/researcher interviews. We triangulated findings from the multiple perspectives of pupil, teacher, and researcher (Flick, 2018). Grounded theory methods were used, which include initial coding, intermediate coding, and selection of core categories (Birks and Mills, 2011). We took a pragmatic approach to coding as recommended by Bryant and Charmaz (2010). For more on how we coded please see Riordan, Hardman and Cumbers

(2021). According to Crotty (1998) Grounded Theory can be understood as a specific type of ethnography which through careful use of a set of procedures (the Grounded Theory Methods) allows theory to emerge from data (and not from elsewhere). We argue that Grounded Theory is suitable for this present study for three reasons. Firstly, the research questions are open-ended and do not involve hypothesis testing, Secondly, Grounded Theory (with 'think aloud' data) has been used before successfully to investigate complicated pedagogy (e.g., Phang, 2009). Finally, grounded theory is action or interaction orientated, according to Strauss and Corbin (1990, p. 104), and so suitable for investigating the complicated multimodal interactions between participants, and between participants and things, discussed in this article. We managed the data using NVivo.

3.3 *Participant Selection*

Riordan, Hardman and Cumbers (2021) included one experienced secondary physics teacher teaching three lessons about chromatography to one class of thirty 13-year-old pupils. Riordan et al. (2021) involved two primary school teachers, one teaching a science lesson to her class of thirty 7-year-old pupils and the other teaching a Religious Education lesson to her thirty 10-year-old pupils. Hence overall there were 95 participants in total (including two teaching assistants in the 7-year-old's lesson). The teachers were recruited by contacting nearby schools directly (a convenience sample).

3.4 *Trustworthiness and Ethics*

The concepts of 'credibility', 'transferability', 'dependability', and 'confirmability' are suitable, according to Lincoln and Guba (1985), for establishing the trustworthiness of qualitative research like the present study. Dependability ensures the integrated processes of data collection, data analysis, and generation of theory are carried out well. Confirmability is the extent to which the findings are supported by the data. Hence, we used the eight techniques proposed by Lincoln and Guba (1985, p. 219) (listed in Table 1 below) during this present study.

We followed the BERA (2018) ethical guidelines and were given ethical clearance from the university Ethics Committee for both studies. For more detail on trustworthiness and ethics please see Riordan (2022).

TABLE 1 Techniques for establishing trustworthiness in qualitative data analysis

Criterion area		Technique
Credibility	1	Activities in the field that increase the probability of high credibility: prolonged engagement persistent observation triangulation (sources, methods, and investigators)
	2	peer debriefing
	3	negative case analysis
	4	referential adequacy
	5	member checks (in process and terminal)
Transferability	6	thick description
Dependability	7a	a dependability audit (and audit trail)
Confirmability	7b	a confirmability audit (and audit trail)
All the above	8	a reflexive journal

SOURCE: LINCOLN AND GUBA (1985, 219)

4 Findings

4.1 *How Often Did Participants Inform, Misinform, and Disinform during Lessons?*

We show next how often we coded ‘information’, ‘misinformation’, or ‘disinformation’ during the five lessons, before using the PAF to understand and explain such multimodal interactions in detail. The categories ‘information, misinformation, and disinformation’ emerged during coding as the researchers used the Grounded Theory Methods (section 3.2). We coded ‘information’ each time a participant communicated well-formed, and meaningful, data (section 2.1.1). Misinformation was coded when a researcher, or other participant, perceived information to be accidentally incorrect, and disinformation when the information appeared to be deliberately incorrect. Source, method, and investigator triangulation were used where possible to support the trustworthiness of these interpretations (section 3.4).

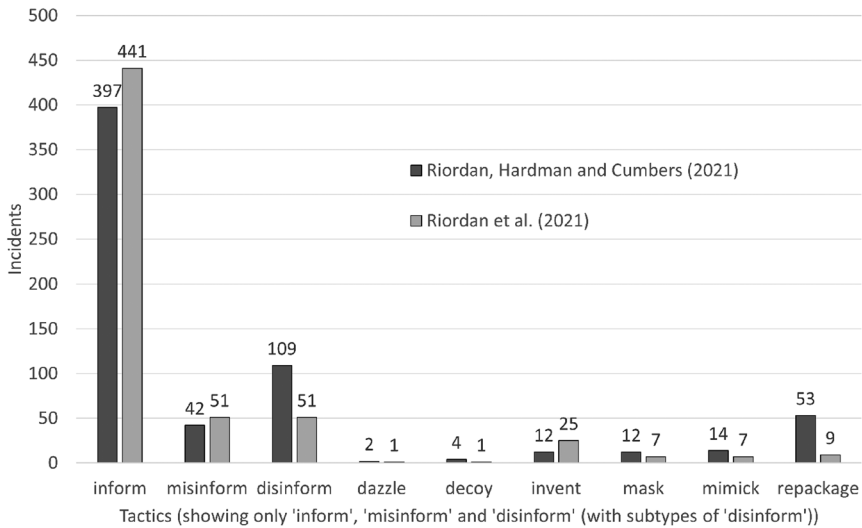


FIGURE 2 A graph showing how often information, misinformation and disinformation were identified over all five lessons (see Figure 2).

Hence participants informed much more frequently than they misinformed in these data. Disinformation was coded more frequently in the secondary than in the primary lessons. All six types of deception discussed in section 2.1.1 were identified, but evidence for some types is sparse in these data.

4.2 *Using the PAF to Understand and Explain the Effects on Pedagogy of Misinformation and Disinformation*

We now clarify how video-based methods and the PAF can help understand and explain how misinformation and disinformation influence classroom pedagogy (see Figure 3 below). We then use the theory in Figure 3 to elucidate an example from the data involving misinformation and disinformation. Firstly, at a certain time the external (or internal) context experienced by a participant and/or prior knowledge₀ may have been influenced by misinformation and/or disinformation. For example, a participant who believes they have been deceived before (prior knowledge₀) may now be anxious (an internal context; 'once bitten, twice shy'). Secondly, as this participant builds known₂, known₁ and/or known₄ unknowns₃ this knowledge too can be founded on misinformation and/or disinformation. For example, a pupil once asked one of us (JPR) why they could not see boats in the sky. This thinking could have been based on misinformation that the sky is blue because it is an ocean. This pupil knew oceans have ships and knew that they did not know why the ocean above their head did not seem to contain boats. Thirdly, a participant may, or

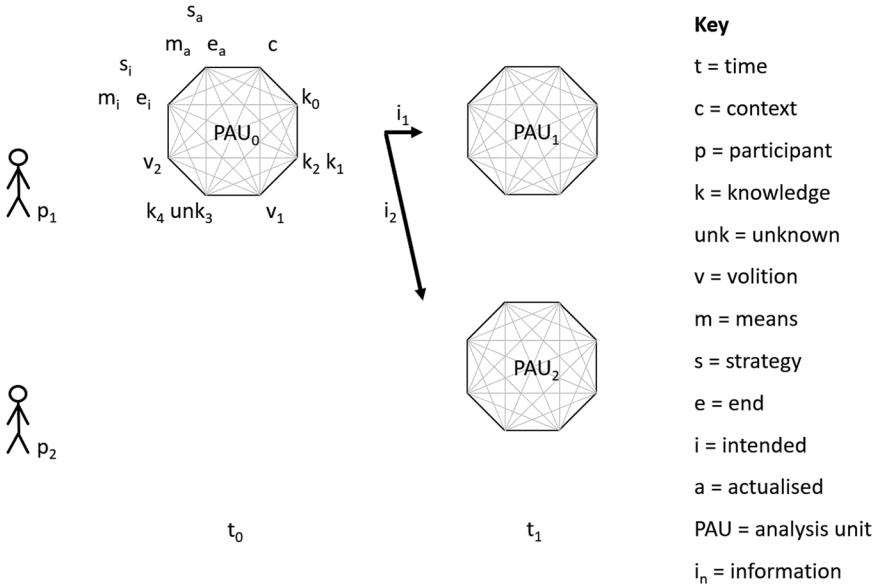


FIGURE 3 Information flow within and between Pedagogy Analysis Units

may not, want (i.e., have volition) to do something, and once again, if they have been misinformed and/or disinformed their volition may have been affected accidentally or deliberately. For example, a participant can sometimes be deceived into believing that their interlocutor wishes something as a way to motivate. So, a teacher may attempt to persuade a pupil to do homework with the argument that nothing gives teachers more pleasure than marking (the pupil may or may not be deceived, and a pupil realising the humour of such exchanges can itself be motivating). If a participant wants to do something this may or may not lead to some intention (involving means_i, strategies_i, and ends_i) and these intentions can be influenced by misinformation and/or disinformation. For example, a participant might intend to use a piece of equipment only to discover it has been misplaced. Finally, this participant acts, or not, using actualised means_a and strategies_a, resulting in changes (ends_a). Again, these outcomes can be distorted by misinformation and/or disinformation. For example, two concave mirrors, one of which has a hole in, with a plastic frog in between can be used in an optical illusion where the frog appears to be above the equipment (but is not actually there). If a teacher tells a pupil to touch the frog, and the pupil reaches out to do so only to discover the frog is not there, then the end of touching the frog has not been actualised as a result of deception by the teacher (both embodied in the physical equipment and expressed in the instruction from the teacher). Hence information (including misinformation and disinformation) flows between

each element of the Pedagogy Analysis Framework (i.e., p_n , t_n , c , k_{0-4} , v_{1-2} , m_i , s_i , e_i , m_a , s_a , e_a), to a greater or lesser degree, and information moves, again to a greater or lesser degree, from each Pedagogy Analysis Unit (PAU_n) to the next. Information₁ (including misinformation and disinformation) from the behaviours of participant₁ and other sources at time₀ influences the pedagogy of the same participant₁ at a later time₁ in PAU_1 . Information₂, potentially not identical to the previous information₁, from the same events at time₀ flows to participant₂ which influences the pedagogy in PAU_2 . PAU_1 and PAU_2 can be contemporaneous, PAU_1 can precede PAU_2 , or PAU_1 can follow PAU_2 . This theory is illustrated in Figure 3. Information, misinformation, and disinformation movements between elements in the PAF and between PAUs are clearly complicated but can be understood and explained using this approach. We argue this theory could be useful to those who wish to untangle complicated classroom pedagogy when video of the multimodal interactions is available, in particular to (or with) student teachers, experienced teachers, teacher educators, and pedagogy researchers.

4.3 *Analysis of One Lesson Transcript Excerpt Involving Misinformation to Illustrate Use of the PAF*

Next, we use a short section of transcript from a year 6 lesson (10–11-year-old pupils) followed by a thick description to illustrate how understanding information movement within and between PAU's (Figure 3), and analysing using video from multiple perspectives (teacher, pupil and researcher), are crucial in pedagogy interpretation when multimodal interactions get complicated. In the thick description tactics are shown in bold and all names are pseudonyms. The video data for this lesson and the corresponding teacher verbal protocol and pupils group verbal protocol are available in the UK data service for archival, research, and teaching purposes (please see the data availability statement at the end and navigate to lesson 2 at time 3:45).

L2:3.45–4.23 **Ms Smith** (a Primary Teacher): The big question of our unit.

The one you were doing for me on that little orange sheet [Ms Smith points to a display] was, creation and science: conflicting or complimentary? Now that's what we're looking at for the rest of today. So, we looked at the biblical Genesis story last week. That's the creation story side of it. This week we're going to look at the scientific theory. And then we're going to have a think about which way we feel. Do they conflict? Are they complimentary? How does it all work. So, first question. What is the scientific theory? So again, with whoever is nearest to you, next to you, whoever is close. What do you think?

See if you can explain to them what your thinking is *before* we have a look at it.

4.23 Lily: The Big Bang.

4.25 **Ms Smith:** OK. What is that? How does that work? Muhammad. Turn around [with a finger gesture]. Talking to these two. [... pupils continue to talk in small groups as Ms Smith moves round asking questions and saying, "Explain it."]

4.53 Sophia: It was either the Big Bang, or the world has been here forever. [...]

5.08 Noah: It was a big meteor.

Ms Smith: Oh. So, the world existed before?

Noah and others: Yes.

Ms Smith: Oh. Then how did the world come to exist? [Ms Smith walks off to talk to the next group] [...]

5.30 **Ms Smith:** Three, two, one. Now, I was being a *right* pain to Noah as I walked round because all I kept saying to people was, "Is it?" "Are you sure?" "Why?" Because what I was hearing from most people was two words [Ms Smith holds up two fingers]. What two words do you think I was mostly hearing?

Olivia and others: Big Bang.

Ms Smith: Big Bang. But that isn't an explanation. It is the name of a theory, but it doesn't explain what you think actually happened. Boys, can we put everything away so we're not being distracted? Thank you very much. So, when I said, *how* does it work. That's an explanation, not 'name it'. 'What's it called?' Jack. What were you thinking?

Jack: I think that there were planets before our planet, and they had come to their dying point, and when they kind of exploded they created new life.

6.16 **Ms Smith:** OK. So that was an explanation. It is not just the name of something. Amelia?

6.20 Amelia: I think the Big Bang is where ... isn't it like this massive asteroid and it came down to Earth as a planet and then created people?

6.30 **Ms Smith:** So, this is why I was winding up Noah's table because they said something very similar, and I said, "Oh! So was the Earth already existing then?". And they went, "Yeah?" [the last word said in a very unsure voice] in a very unsure way. Because I was asking them unhelpful questions.

The teacher begins by **informing**₁₋₄ the class what the overall aim of the topic is, what they did previously (a Genesis creation story), will do now (the Big Bang Theory) and will do next (a comparison of a creation story and this scientific theory). She then **instructs**₁ the pupils to explain the science to each other. Lily says, “The Big Bang” (4.23; another **inform**₅) and Ms Smith counters with two **questions**_{1&2} to prompt an explanation. This type of questioning Chin (2007, p. 823) calls “reflective toss” by which Chin means using a question to give responsibility for thinking back to the pupil. Ms Smith tells (**instruct**_{2&3}) some pupils to turn around and talk with their group. Sophia then notes that either the world started at some point, or it has existed forever (**inform**₆; 4.53). The former is explored during this lesson, but the latter is not. Explaining the scientific evidence for the Big Bang and against an eternal universe would be challenging for colleagues who may not have level 3 or above physics qualifications (i.e., microwave background radiation, Olber’s paradox, etc.) and such an explanation may be beyond most learners of this age anyway. Noah claims the Big Bang was a meteorite strike (**misinform**₁) perhaps confusing the Big Bang with the meteorite that seems to have caused the extinction of the dinosaurs. Ms Smith, apparently a little surprised, asks (**question**₃) if the world existed before the meteorite, and the pupils answer ‘yes’ (**inform**₆). A theory for the origin of the world cannot presuppose the existence of the world. Ms Smith asks again how the world came to exist and the discussion continues. Ms Smith **instructs**₂ the group to stop (using the countdown tactic), then **informs**₇ the group that she was being, “a *right pain*” (5.30) by asking questions to seek an explanation when pupils had been simply informing her of the name of the theory. After a **question**₄ and a brief **instruction**₃ to some pupils to get on task she reminds (**inform**₈) the pupils that she asked originally for an explanation, and that this involves saying how the Big Bang worked. Following another two **questions**_{5&6}, Jack explains that as previous generations of planets exploded this created life (**misinform**₂). Planets do not spontaneously explode, but large stars do (called supernovae). Supernovas fuse small atoms to make bigger ones and spread this matter. Planets, and life on those planets, form from the detritus according to science. So, this explanation (acknowledged as such by Ms Smith; 6.16) highlights, with the minor mistake (**misinform**₂) of saying ‘planet’ instead of ‘star’, part of the scientific theory which connects the Big Bang with life on Earth (i.e., where the material for life came from). Then Amelia claims the Big Bang was an asteroid collision on Earth which created people (**misinform**₃). Hence Amelia reiterates the ‘misconception’ of Noah earlier (5.08), probably confusing the extinction of the dinosaurs with the Big Bang, but unlike earlier

claims the collision created people. Here misinformation₁ from earlier may have influenced this subsequent misconception, and the pupil and teacher perspectives are necessary to establish if this is likely to be the case or not. The way Amelia changes midsentence from a **misinform**₃ to a **question**₄ in 6.20 perhaps indicates self-awareness that she is not confident, or has lost confidence, in her argument during the sentence (i.e., possible conceptual change). Ms Smith then refers (**inform**₇) to the point she made earlier to Noah's group (5.08) that their theory did not explain how the world came to exist. Ms Smith tells the story of this earlier exchange with added drama in the way she says she was "winding up" Noah and in how she imitates this pupil's voice (e.g., Ms Smith says the word 'Yeah?' in a very hesitant way; 6.30). Winding up means, "to annoy, to provoke deliberately (*colloquial*)" (OED). Ms Smith's intended end ('a pupil explains the Big Bang') at 4.20 is not actualised, and neither is Lily's intended end when he responds at 4.23 ('to answer Ms Smith's question'). The subsequent Ms Smith strategy at 4.25 (later described by Ms Smith as 'winding up') does eventually achieve an explanation from Jack, but not a correct one. The way Ms Smith explains her strategy as 'winding up' (at 6.30–6.43) has perhaps an intended end of the pupils understanding that their previous answers had not been explanations (i.e., a metacognitive intended end) and that more is needed. 'Winding up' is the teacher using language that the pupils could understand, and in a follow-up interview (TVP 3.05–3.10) this teacher commented on the passage above, "with adults you'd say you were playing devil's advocate, but they just don't know that phrase." Playing devil's advocate involves pretending to take a position in a discussion, a type of deception Whaley (1982) called 'inventing' (a kind of simulation where a different reality is displayed). We argue that the video-based research methods of teacher and/or pupil group verbal protocol can sometimes help resolve such pedagogy analysis conundrums, and that the PAF and PAU give a framework for understanding and explaining complicated interactions like this in classrooms. The transcript above lasted just under three minutes and included approximately twenty-four tactics. The entire data set lasted just over 6 hours and 2,715 elements within the PAF were coded, so this represents less than 1% of the analysed data (by time).

4.4 *Participant Perceptions of the Status of Information*

Next, we introduce another theoretical finding of this study regarding participant perceptions of information, before illustrating how this idea can help by analysing a short transcript excerpt. Different participants, at any particular time, may perceive the status of information (i.e., whether it is information,

misinformation, or disinformation) in the same way or differently. As time continues, a participant can keep the same understanding of this status, or this understanding can change. To illustrate, when considering triad interactions this leads to sixteen potential perceptions of the status of information which will now be explained, illustrated in Figure 4, and then exemplified. Here one participant₁ informs two others (p₂ and p₃) where any of these participants may or may not think that the information given is information (i.e., ‘correct’ to the best of their knowledge), misinformation, or disinformation. Please note that we have assumed in this model that participant₂ and participant₃ are interchangeable, so for example type 3 (i, i, i_m, i) would be identical to (i, i, i, i_m), which is why some unnecessary permutations are not shown in the table. Much of the time (see Figure 4 type 1) one participant₁ might inform the other two of something, and all three may believe this information to be correct (whether this information is ‘true’ or not is an open question). However, whilst p₁ informs p₂ and p₃ the informer (p₁) can believe that they are misinforming. For example, the realisation that the words one has just spoken are not correct (as possibly illustrated earlier in the transcript at 6.20). We will explain one further example (see type 13) to show how messy this can get before illustrating all sixteen permutations and combinations in Figure 4.

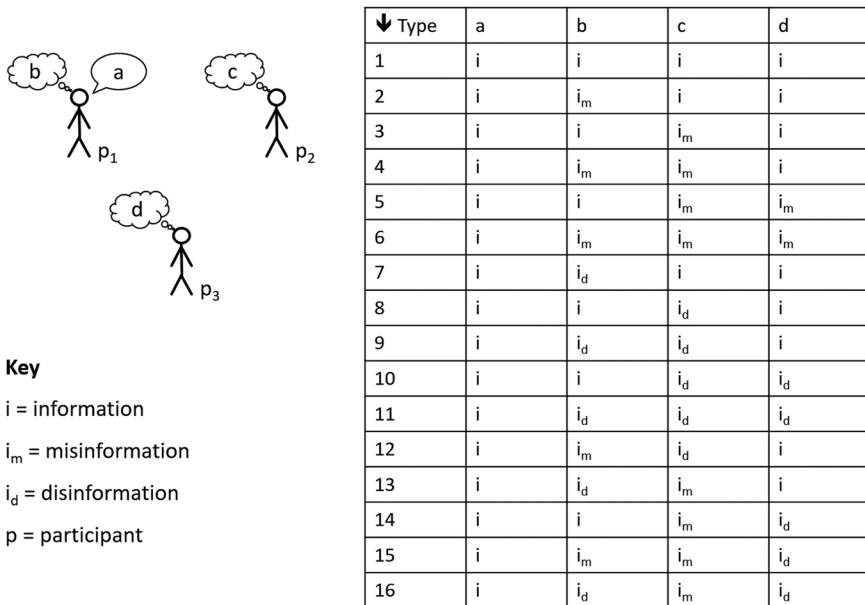


FIGURE 4 Information, misinformation and disinformation, perception types when one participant₁ informs two others (p₂ and p₃)

A participant₁ may inform but know themselves that this is disinformation (note that this could be for nefarious reasons, i.e., a lie, or not). Meanwhile one of the other participants₂ may think that the first has made a mistake (i.e., that participant₁ misinformed), whilst the third participant could believe the information imparted is correct.

Next, we illustrate participant perceptions of the status of information with an example from the data. To find this video please see the data availability statement at the end and navigate to ‘Teacher Verbal Protocol 2’ at time 59.03).

59.03–1.00.03 **Ms Smith:** So just trying to ... again keep it *to them* [Ms Smith’s hand gesture indicates separation of one group of pupils from the others], so everybody else is still busy ... everybody else is still talking and have no idea that I’m chatting to that group. So, they said at the end, “They had to go out and practice, didn’t they? They hadn’t been getting on.” But that was as much as they spotted. They didn’t know what had really been going on in the meantime. So yeah, just trying to keep that *slightly under the radar* [the previous four words are emphasised with a higher pitch tone], and it has been *pretty positive up until this point* [same emphasis with higher pitch]. I’ve come and helped. I’ve come and made sure that you *know* what you’re doing and *how* you could fix this. But now we’ve got to the point where, “It is not fixed, and you’re meant to be showing us what you’re doing in two minutes”. So, we’re going to have a little bit of – cross voice, and then you’re going to go outside and fix it. So, I would not have asked them to go up and do what they’ve done [Ms Smith’s slight laugh in her voice indicates the absurdity of her suggestion here] at the level that they had to because that would have just been embarrassing for them. But the knowledge that it might have happened, boy did they work quick when they got outside! [Ms Smith and JPR laugh]. It was slightly longer than two minutes in the end, they had about five minutes to practice it, but what they got together in the time that they then had. They were like, “Right, we had better do that!”

This passage begins with Ms Smith explaining how her intended end is to keep the information about her intervention with a small group of miscreants from the rest of the class (**disinform**₁ of the type 'hide'; type 7 in Figure 4). Ms Smith notes that the wider group later in the lesson were aware that the small group had been sent out to practice, but that the information about the behaviour of the small group was limited ("that was as much as they spotted"). Ms Smith describes this pedagogical deception (**disinform**₁; clearly with good intent) as keeping her intervention "slightly under the radar", a metaphor she has used earlier in this interview once before (23.16). Ground interference with radio waves meant planes that flew low during World War 2 could not be detected, so flying low could be used to hide. Ms Smith describes how she has tried to help this group with three supportive interventions, but now explains how she adjusted the type of authority used with the small group with two tactics (**inform**_{1&2}) clarifying the problem to these pupils, accompanied by a change in intonation which indicates her feelings (mild anger). The "cross voice" is used tactically ("we're going to have a little bit of – cross voice") alongside two **instructions**_{1&2} (i.e., "you're going to go outside and fix it"). Ms Smith explains that she would not have made the pupils perform at this moment as their lack of preparation would have made this embarrassing for them, but she notes that the pupils may have been in some doubt as to whether Ms Smith would make them perform and this slight fear may have motivated this small group (i.e., the disinformation from the teacher may have been perceived as information by some of this small group of pupils; see Figure 4 type 9). The way Ms Smith, perhaps deliberately, leaves doubt in the minds of the participants in the small group can be interpreted as a second **deception**₂ in this passage (again, clearly with good intentions). Hence the model for information, misinformation and disinformation perception types in Figure 4 can help the analysis of complicated pedagogical interactions in the classroom, especially when video is available to help.

4.5 *Overlapping Information, Misinformation and Disinformation*

Next we introduce another theoretical finding of this study regarding how information, misinformation, and disinformation can overlap before again illustrating the utility of this theory by analysing an excerpt from the classroom video data. Conceptual change research identified 'synthetic concepts' where a participant combines scientific knowledge with a 'misconception'. For example, some children merge the ideas of the 'sphere Earth' and 'flat Earth' to form the

synthetic concept that humans live on a flat surface inside a ball (Vosniadou and Brewer, 1990; Driver et al., 2015). Hence information, misinformation, and disinformation can overlap or not, and in Figure 5 below we identify the eight ways in which this can happen.

We now illustrate this idea of overlapping information, misinformation and disinformation with an example from the data. Later in the same lesson as above the pupils were put into small groups of about 7 by the teacher to role play the Big Bang to the other groups. Pupils watching then gave the actors formative feedback. To find this video please see the data availability statement at the end and navigate to ‘Pupil Group Verbal Protocol 2’ at time 38.56).

38.56–39.19 Theo: All the dust and gas that was left over [from the Big Bang and star formation] formed into spinning discs called plan-
etoids which got bigger as they collided to form planets [the others
in the group role play these changes as Theo narrates]. As they got
bigger the gravity got stronger and started to turn them round [one
actor, Ava, starts to turn] [...] then they started to form an atmos-
phere. [...]

Scientists do think that planets formed just as Theo explains above from the debris of the Big Bang and several generations of exploded stars, but planets turn because the huge gas clouds from which they form are rotating slowly, and the angular momentum is conserved when gravity causes the cloud to collapse. Hence the planet rotates more quickly than the gas cloud did in the same way that a spinning ice dancer rotates faster when arms are contracted. Here Theo appears to think that the reason planets turn is because gravity ‘got stronger’ and starts them turning. This misunderstanding may be related to the Aristotelian misconception that an unbalanced force is required to maintain motion. Here information and misinformation are combined, as illustrated by ‘e’ in Figure 5.

4.6 *Information Communication Difficulties*

Next, we discuss how communication difficulties in the classroom can relate to misinformation and disinformation before illustrating this idea using a transcript excerpt. Classrooms are often noisy places, and the message a participant seeks to communicate does not always arrive intact. Sometimes this is through no one’s fault (e.g., “I didn’t catch that.”), but at other times a

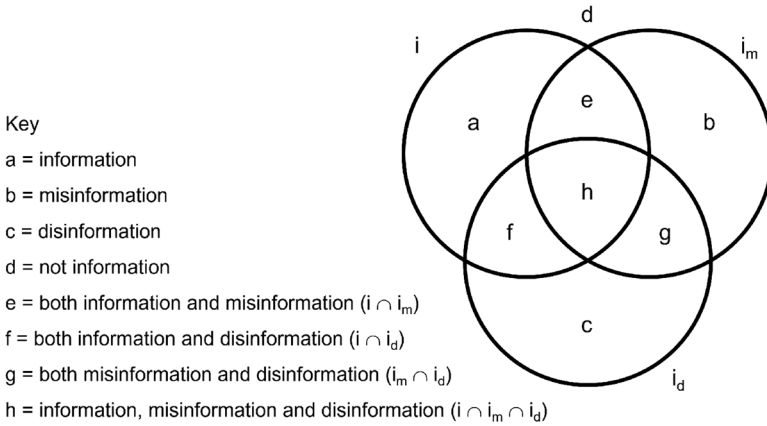


FIGURE 5 How information, misinformation and disinformation can overlap

participant can deliberately interfere with their own communications (e.g., purposeful lowering of the volume of one's voice so another participant will not hear), the communication of another (e.g., "I'm not listening!" with fingers in the ears), or communication between other participants (e.g., deliberate noise making to prevent others communicating). Information communication difficulties can therefore cause misinformation and/or may be caused by deception. We next use terms adapted from the classic work of Shannon (1993) and illustrated in Figure 6 to discuss briefly information communication difficulties in the classroom. We acknowledge that applying the Shannon-Weaver model to interpersonal communication is contested in the literature (e.g., Gozzi, 2004), but nevertheless find it useful in this discussion. A full analysis of communication difficulties in classrooms is beyond the scope of this current article. A participant (p_t) has a message (i_t) which they communicate by converting it into data (d_t) (e.g., sound waves). Because of a noise source or sources (n ; note this may be auditory noise but could be of other sorts) the data (d_t) another participant (p_r) receives may not be the same as that which was transmitted. Hence the message received (i_r) may or may not correspond to the message transmitted (i_t).

Next, we illustrate information communication difficulties with an example from the same lesson as above. To find this video please see the data availability statement at the end and navigate to 'Lesson 2' at time 17:01).

17:01 **Ms Smith:** So, Ava, what do you reckon?

Ava: I think atoms they collided and then they formed plants and animals.

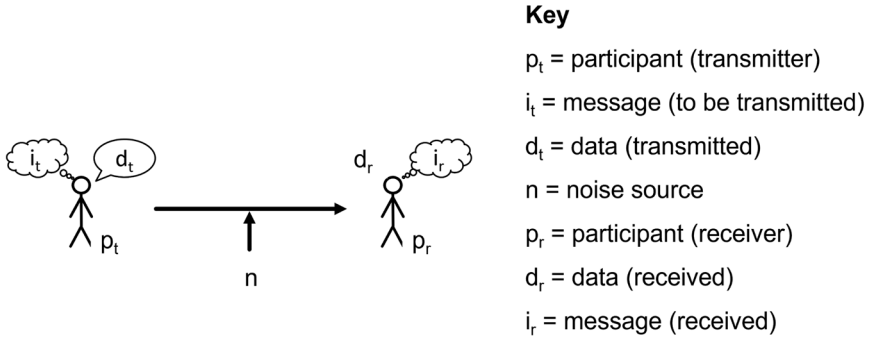


FIGURE 6 Information communication difficulties (adapted from Shannon, 1993)

Ms Smith: So, you think that the atoms that existed out in that universe [Ms Smith points at an image on the Interactive Whiteboard representing the Big Bang and stages in the development of the universe] sparked together [Ms Smith uses both hands to gesture something colliding] and started life off.

17.14 Ava: Bacteria.

17.15 **Ms Smith:** [Ms Smith points to her ear and leans forward indicating difficulty in hearing Ava] So ... good ... so starting with something like bacteria. [...]

At 17.15 the gesture (**action₁**), body position (**action₂**) and words (**inform₁**) of this teacher indicate that the information this pupil communicated (i_t) at 17.14 had not been received (i_r).

5 Discussion

Pedagogy analysis is often relatively straightforward, but this is not always the case, particularly when misinformation (accidentally wrong information) and disinformation (deliberately wrong information) are factors. We have shown how information, misinformation, and disinformation can influence the pedagogy of participants in a classroom as these people interact (with each other and with things) and how video-based methods and the PAF can help understand and explain this. As an understanding of how information, misinformation and disinformation can influence pedagogy is necessary for teachers, teacher educators, and pedagogy researchers, we argue that the theories in this article could help deepen that understanding. In addition,

this article has argued that the following concepts are also needed for pedagogy analysis alongside the PAF: perceptions of the status of information; overlapping of information, misinformation, and disinformation; and information communication difficulties. Future research could investigate, using video-based methods like those in this article, how school mentors use classroom video to help Early Career Teachers untangle complicated classroom pedagogy (which may include misinformation and disinformation).

5.1 *Originality*

We now use Wellington's (2012) criteria for originality. The use of video-based methods and the PAF in this article to understand and explain how information, misinformation, and disinformation influences classroom pedagogy is an original approach resulting in new knowledge. Linking the PAF to information, misinformation, and disinformation literature is original. The representations of the PAF and PAUs in Figure 3 is novel. To the best of our knowledge, a detailed theoretical discussion like the one in this article, using video-based methods, Multimodal Classroom Interaction Analysis, and Straussian Grounded Theory of how information, misinformation and disinformation influence classroom pedagogy, is new.

5.2 *Significance*

How can video-based Multimodal Classroom Interaction Analysis research using Straussian Grounded Theory, and the PAF theory, contribute to the visual pedagogy literature? First, the PAF is a formal grounded theory that emerged from a series of video-based studies of classroom pedagogy, so we think it well-suited as a tool to aid visual pedagogy analysis. Pedagogy analysis matters because it can inform good teaching, and good teaching facilitates learning (Hattie, 2009). Second, we think multimodal analysis of complicated pedagogical interactions needs triangulation between different sources, so the ability using video-based methods to revisit related passages of data is useful. For example, we have argued in this article that participants can disagree in their interpretations regarding information, misinformation, and disinformation, so the video-based research design that compares interpretations from the perspectives of teacher, pupil, and researcher is valuable. Third, we argue that Multimodal Classroom Interaction Analysis using Straussian Grounded Theory and video-based methods to investigate complicated aspects of pedagogy from multiple perspectives is a novel and useful approach to complement other visual methodologies used in educational research (Wall, Hall, and Woolner, 2012).

5.3 *Limitations*

We identify four key limitations to this work. First, the focus of this article has been on misinformation and disinformation in the learning environment of a school classroom, and we acknowledge that what Parker, Liu, and Smith (2023) call ‘the new information environment’ is much broader than this, including for example the challenges posed by information abundance. Second, interpretations of intentions and actions of participants in a complex environment like a classroom can only ever be tentative. Third, this qualitative research prioritises depth of analysis over breadth, so combining this work with studies exploring the bigger picture would be wise. Finally, the lessons were from only two subject areas (Religious Education and science) with three different age groups. We recommend using the video-based methods and PAF to investigate more subject pedagogies and across an even wider age range.

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7 Data Availability

The data that support the findings of this study are available in the UK Data Service ‘ReShare’ (<https://reshare.ukdataservice.ac.uk>) at www.doi.org/10.5255/UKDA-SN-854915.

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9 Conflict of Interest

The authors declare there is no potential conflict of interest.

10 Ethical Approval

The compliance with ethical standards was approved by the Canterbury Christ Church University Ethics Committee (reference ETH2021-0157).

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