Dublin Institute of Technology
ARROW@DIT

Other resources

School of Art, Design and Printing

2010-01-01

Do You See What I Mean? Computer-Mediated Discourse Analysis

Noel Fitzpatrick
Dublin Institute of Technology, noel.fitzpatrick@dit.ie

Roisin Donnelly
Dublin Institute of Technology, roisin.donnelly@dit.ie

Follow this and additional works at: http://arrow.dit.ie/aaschadpoth

Part of the Arts and Humanities Commons

Recommended Citation
Fitzpatrick, N., Donnelly, R. :Do You See What I Mean:: Computer-Mediated Discourse Analysis. IGI Global, 2010. DOI: 10.4018/978-1-61520-879-1.ch004

This Book Chapter is brought to you for free and open access by the School of Art, Design and Printing at ARROW@DIT. It has been accepted for inclusion in Other resources by an authorized administrator of ARROW@DIT. For more information, please contact yvonne.desmond@dit.ie, arrow.admin@dit.ie.

This work is licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 License

Do You See What I Mean? Computer-mediated Discourse Analysis

Noel Fitzpatrick and Roisin Donnelly
Dublin Institute of Technology, Ireland

ABSTRACT
This chapter explores a sociolinguistic approach to computer-mediated communication (CMC), by examining how higher education teachers use digital media to manage interpersonal interaction in their online courses, form impressions, shape and maintain relationships with their students. Previous studies have often focused on the differences between online and offline interactions, though contemporary research is moving towards the view that CMC should be studied as an embedded linguistic form in everyday life.

The study of language in these contexts is typically based on text-based forms of CMC, (often referred to as computer-mediated discourse analysis). Within this, focus in the chapter is on the devising and implementation of pragmatic linguistics of online interactions; at a high level this refers to meaning-making, shared belief systems and intercultural differences; at a specific level this includes issues such as turn-taking and the sequential analysis and organisation of virtual 'interlocution'.

KEYWORDS
collaborative learning; computer discourse analysis; computer-mediated communication; interaction; pragmatic linguistics; social constructivism; sociolinguistics

INTRODUCTION

This chapter provides a critical view of the present state of play in different strands in computer-mediated communication (CMC) research. By focusing on the literatures of social interaction, constructivism and linguistics, a critical discussion of key theories and resulting emergent arguments in the use of CMC in higher education (HE) is provided. Given the rapid development of technologies and their resulting literatures of usage in higher education today, it is argued that this chapter is very relevant to all whose practice is influenced by learning technologies – such as educational technologists, education policy makers and administrators, higher education teaching and research staff, advanced education students, designers of virtual education environments and similar teaching tools, psychologists of third-level education.

Throughout the chapter we reflect openly on current difficulties in several areas. The chapter begins with consideration of the selective and nearly exclusive reliance on social constructivism as the 'philosophy' underpinning computer-mediated learning, while its legitimacy has not been validated by formal research with adequate control groups. A subsequent section explores the validity of assessing knowledge construction through merely quantitative, or even exclusively automatic, analysis of interactions, implying that there is nothing else to knowledge that is different from quantitative factors. Thereafter, a section looks at the attribution of the benefits of asynchronous CMC to the technology rather than to tutor intervention and the underplaying of the value of memorisation as opposed to 'real understanding'.

Specific problematics in the field are then highlighted including the excessive claims of the benefits of online collaboration as a method of creating learning, which is based in no more than anecdotal evidence and an inherent confusion between theory and practice with regard to the nature of knowledge. Alongside this, there is contemplation on the emphasis of constructing afresh online communities of practice which are essentially organic structures that should be encouraged to grow, live and die naturally.

Finally, the chapter explores the severe difficulties of automatic content analysis, which remains at an unsatisfactory impasse to this day. Impediments here centre on the observation that meaning-making has taken place or can take place outside the formal learning space provided and the continuing need for frequent, personal, direct, real-time interaction between tutor and student, to supply direct encouragement and feedback. Of utmost importance is the need to take into account physical and cultural context, which is currently unrealised in computer communication.

Terminology and History

As all of the terminology used in the chapter is well known to the target audience of the chapter, we do not define terms per se; however, we believe it will be useful to deconstruct 'social constructivism' in the context of the work. Constructivism is not a unitary theoretical position; rather, it is frequently described as a continuum. The assumptions that underlie this continuum vary along several dimensions and have resulted in the definition and support for multiple types of constructivism. Typically, this continuum is divided into three broad categories: cognitive, social and radical constructivism.

Computer-mediated communication first appeared in the 1960s in the USA as means of transferring computer programs and data between remote computers in the interest of national defense (Levy, 1984; Rheingold, 1993). The educational potential was soon explored through early experimental dialogue systems, based on a 'socratic dialogue' methodology (Feurzeig, Munter, Swets, & Breen, 1964). The first analysis of computer-mediated discourse appeared in 1985, where Dennis Murray gave a very detailed analysis of the types of discourses which were prevalent in CMC. Since the early 1990s there has been a rapid growth in research into computer-

mediated communication and computer-mediated discourse, the complexity of communicative situations with humans interacting together through computers has turned out to be much more multifaceted than originally envisioned. In the extensive literature on asynchronous online discussions, within the realm of computer-mediated communication, there is widespread agreement that online discussion enables interaction which would otherwise be difficult to achieve in face-to-face situations. (Conole & Oliver, 2007). There is a widespread acceptance, for example, in second language acquisition, that the use of electronically mediated communication has definite benefits for learners (Thorne, 2006; Warschauer, 1996). The benefits which are cited range from the acquisition of metalinguistic structures such as grammar to pragmatic competence and intercultural competence. Language learning was one of the early adopters of CMC, and the benefits of usage to second language acquisition have been well documented in the field for over two decades (Belz & Kinginger, 2002; Thorne, 2006; Warschauer, 1996). From a general educational perspective Henri (1992) sees CMC as 'a goldmine of information concerning the psycho-social dynamics at work among students, the learning strategies adopted, and the acquisition of knowledge and skills' (p. 118). Computer-mediated communication is fast becoming an area of active research in a number of disparate fields: psychology, digitial media studies, e-learning educational research and linguistics, in particular computational linguistics and pragmatic linguistics. However, when one examines the typologies being used, in general there is a commitment to the two main forms of online interaction, between students themselves, and students and tutor, which is often associated with a social constructivist approach to learning and teaching (Angeli, Valanides, & Bonk, 2003; MacDonald & Twining, 2002). Indeed, computer-mediated communication is often cited as a prime example of social constructivism in action. Computer-mediated communication is seen to have wider educational and social implications including from an egalitarian perspective the democratic development of students. Yates's 'democratic theory' focuses on the emancipatory aspects of its use (Yates, 1996).

A review of the research literature shows that reports centre on relatively high rates of student participation with evidence of two fundamental facets of social constructivism: co-operative learning (Aviv, Erlich, Ravid, & Geva, 2003; Hawkey, 2003; Hiltz, Coppola, Rotter, & Turoff, 2000), and higher order thinking and knowledge building (Curtis & Lawson, 2001; McConnell, 2000; Thomas, 2002). However, analysis of participation rates and evidence of co-construction of knowledge based on quantitative data from learning management systems have misconstrued the issue slightly. The evaluation of co-construction of knowledge based on quantitative analysis of discussion posting underestimates the complexity of the issue at hand. More fundamental questions about what these participation rates mean and what does it mean to co-construct knowledge are beginning to emerge. There is *discontent* with content analysis of online discussion fora because the methodologies being used are not yielding the expected results of evidenced construction of knowledge online (Guevarra Enriquez, 2009). The widespread use of CMC in higher education and the need to assess students' performance, the attaining of the learning outcomes, in measurable terms is leading to developments in the analysis of CMC data. There is an inherent relationship, therefore, between the search for evidence of learning and the types of technology that are being used to facilitate the learning.

Various aspects of CMC have received scrutiny across a number of disciplines. Yet the adoption of CMC in university courses has developed faster than the understanding of how it should best be used to promote higher-order thinking and learning (Garrison, Anderson, & Archer, 2001). There is much debate within linguistic circles about the influence electronically mediated communication is having on language usage; there have been rapid developments in linguistic expression, such as the use of abbreviations, emoticons and textspeak alongside the developments of technology. Perhaps it is still too early to fully encapsulate how communication has changed with the widespread adoption of internet technologies (Baron, 2008). Currently, within

educational research and practice, diagnosing the online interactions specifically related to knowledge and expertise exchanges is challenging. Much research is concerning itself with the identification and exploration of frameworks for the understanding and measurement of high level thinking in computer conferences. The underpinning presumption is that through the online exchange there is a record of knowledge being constructed before our very eyes.

> Traditional theories of learning treat learning as a concealed and inferred process something that 'takes place inside the learner and only inside the learner'. CSCL[1] research has the advantage of studying learning in settings in which learning is observable and accountably embedded in collaborative activity. Our concern, therefore, is with the unfolding process of meaning-making within these settings, not so-called 'learning outcomes'. (Koschmann, 2001: 19)

We are being afforded a unique opportunity to glimpse at the learning taking place, the unfolding of new meaning-making before our very eyes on the discussion boards. The traces of social constructivism should, therefore, be present within the online exchanges. However, as we shall see, this is very much an oversimplification of what computer-mediated discourse is and, at a more profound level, an oversimplification of what knowledge construction, communication and indeed what language are.

CMC is defined here as predominantly text-based human–human interaction mediated by networked computers or mobile telephony, which includes, email, asychronous discussion boards, blogs and wikis. Whilst many tools available to education today may be used in CMC, such as social networking, bookmarking sites, and Twitter to name a few, the evaluation of the technology seems to be mixed.

Nonetheless, the very classification of what CMC is and how it should be classified is an object of debate in itself, at the moment there is no consensus as to how this should be done. Susan Herring has advanced a faceted classification scheme for computer-mediated discourse (Herring, 2007). This classification adapts the traditional typology of discourse analysis to the online environment, including modality, number of discourse participants, text type and discourse type, and genre or register. Her new typology includes facets of online communication in educational environments such as purpose, topic, tone and activity. Claimed benefits of the asynchronous and virtual worlds are opportunities for multiple connections, the easy storage and manipulation of the text, the opportunity to interact more thoughtfully, to more people, more often, in a way in which both teacher and student feel comfortable (Ham & Davey, 2005). Other HE-level studies report advantages such as extending classroom discussions, increasing time management ability, self-directive behaviour, self-confidence and self-discipline (Hammond & Wiriyapinit, 2005; McFerrin, 1999). Arguably, creating such effects is more a function of tutor intervention and planning than it is a built-in benefit of the technology itself.

BACKGROUND

It is interesting to point out that the widespread adoption of social constructivism in higher education has been coupled with the rush to put in place large virtual learning environments and learning management systems. The virtual learning environment Moodle, for example, explicitly expounds social constructivism as part of its learning and teaching philosophy. It appears that social constructivism has become the acceptable face of higher education (Fitzpatrick, Hayes, & O'Rourke, 2009). The social constructivist perspective of learning and teaching regards computer conferences as a virtual space where knowledge is codified, exchanged and constructed (Curtis &

[1] Computer Supported Collaborative Learning

Lawson, 2001; Wilson & Stacey, 2004). It has been privileged in CMC research over other common philosophical theoretical constructs. While it covers a grouping of theories and should not be seen as an all-encompassing unified theory of learning, there are common traits which are presuppositions about the nature of language and knowledge; following on from Vygotsky (1978), language is seen to be socially constructed and knowledge is also taken as a social construct. Likewise, from our own research experiences and practices into CMC, the philosophical approach which appears to be most convincing is the paradigm of social constructivism. Perhaps not in practice, but certainly in the literature, other theoretical constructs tend to be devalued. Indeed, published views are surprisingly normative, almost ideological, in favour of a collaborative and dialogic practice that excludes other theoretical paradigms. Other learning theories such as, behaviourism, humanism, situated learning and activity theory are generally skipped through in the literature relating to technology enhanced learning and CMC. Although the significance of CMC, in relation to the social constructivist theory is well documented in research literature (Berge, 1995; Jonassen & Reeves, 1996; Resnyansky, 2002), the research relationship is often tentative. Indeed Hendricks and Maor (2004) argue that hard evidence linking CMC to social constructivism has not been fully supported by research, as the majority of studies were often anecdotal or descriptions centering on individual experiences. The main problem with this is the use of small samples of discourse data, and as a result, the studies often do not accurately describe the cognitive processes of the students nor illustrate how knowledge develops and grows across time and across topics. Not surprisingly, CMC researchers continue to urge further investigation into the quality of student learning through CMC. However, there is a movement towards other types of content analysis such as speech acts, genre, roles and goals of interlocutors which are beginning to show some interesting results (Guevarra Enriquez, 2009).

In its conceptual presuppositions and in the diverse applications derived from them, social constructivism has applications in the following aspects of learning strategies which are of great relevance to our own practice as educational developers in higher education:

- It is centred on the learner more than on the content. Such a personally targeted approach, means the learner can learn more than is possible from an abstracted approach where there is a common objective for all.
- It is focused on 'deep' rather than 'surface' learning and on 'productive' rather than 'reproductive' tasks.
- It encourages a real understanding of content rather than a mere memorisation; essentially this is the ability of the individual student to appropriate/assimilate content and to give it personal meaning rather than an ability to replicate information.
- It is interested in the transference of learning from the classroom to real-life situations/context.
- It facilitates the development of cognitive, metacognitive and social abilities, which are fundamental to continuous learning in today's so-called 'knowledge society'.

However, there is an appearance that collaboration follows a neat cycle of student-to-other dialogue with better learning as the presumed result. Within this neat cycle there are presuppositions made about the speaking subject, interlocution[2] and creation of meaning. Too much evidence for broad, sweeping claims about the efficacy of online collaboration is based on

[2] Interlocution refers to the social context of the use of language. The utterance is grounded in the context through the positions of interlocutors as addressee and adressor. The analysis of interlocution rather than dialogue allows the wider context of communication to be considered; see Benveniste (1971).

anecdote, lending the appearance, if not the reality, of an ideology rather than researched CMC practice. A further issue to compound this is that collaborative methods quite often represent a mix of pedagogies, difficult to sort out and test in empirical research, that remain unproven in terms of validity. This chapter addresses this by delving into CMC research practices, specifically on CMC discourse analysis. One of the presumptions behind the models currently being used to analyse discussion fora is that the construction or co-construction of knowledge will be present within the dialogues taking place. However, when tested this presumption seems to lead to oversimplifications about the nature of online communication and the nature of new meaning-making. It might be more judicious to speak of the evidencing of knowledge construction which takes place on the educational discussion boards rather than the co-construction of knowledge itself. The underlying epistemological confusion in social constructivism comes to fore once research for co-construction of knowledge is examined in detail. There is an inherent confusion between theory and practice in much of what is reported under the social constructivism banner in regard to what knowledge construction is. Those of a more philosophical bent stand back in horror when the ultimate epistemological relativism of social constructivism is overlooked (Boghossian, 2006). There is, therefore a tension between how knowledge is viewed in social constructivism and the very hierarchical structure of most educational institutes.

The analysis of discussion boards needs to take into account the context of the language usage. It should never be far from our minds that we are dealing, in higher education, with education discourse where students are required to demonstrate that they have learnt. A more Foucauldian analysis would point to the inherent power structures which are in place and which make up that discourse:

> discourse is not the majestically unfolding manifestations of a thinking, knowing, speaking subject, but, on the contrary, a totality, in which the dispersion of the subject and his discontinuity with himself may be determined. It is a space of exteriority in which a network of distinct sites deployed. (Foucault, 1966: 55)

The speaking subject and the manifestation of thinking are presuppositions in most analysis of what is taking place on CMCs in higher education. It is, therefore, worthwhile opening the space where a re-evaluation of the learning that is supposedly manifest could take place.

Once language and knowledge building are presumed to be socially determined and socially constitutive, the analysis of the 'community' becomes of paramount importance. The 'community' will be the bedrock of meaning-making, knowledge building and knowledge sharing. Based on extensive research in the field, McConnell (2006) has concluded that there have been many attempts to characterise Internet 'communities', and educational communities, but surprisingly little examination of actual, existing educational communities. Much is now known about the theory of establishing communities but very little about how these theories (such as social learning theory) work in practice. Little is known about what actually takes place in an e-learning community and what members of communities do in those settings. Wenger's model of communities of practice (1998) has been widely discussed and adopted and has been very influential in the area of online communities. It would seem, at first glance, slightly contradictory to construct communities of practice which are essentially organic structures which should be encouraged to grow, live and die naturally. The challenge is, perhaps therefore, to harness the organic benefits of online communities for sharing and learning within more formalised educational structures.

However, Holmes, Tangney, FitzGibbon, Savage, and Mehan (2001) have argued for an expanded definition of social constructivism that takes into account the synergy between the more

recent advances in information technology, which are increasing our potential for communication and these ideas outlined above. With communal constructivism, students and teachers are not simply engaged in developing their own information but actively involved in creating knowledge that will benefit other students and teachers; the focus is on learning with and for others. Within the context of professional development courses in higher education, peer tutoring is an obvious outlet for a communal constructivist approach. A social and communal constructivist approach adopted in the design and delivery of such courses can emphasise active and student-centred learning. Developing lifelong learning skills is also important, alongside learning in context.

Content Analysis and the Co-construction of Meaning

The ultimate aim of adopting a concerted approach to researching CMC in higher education is to understand how students interact online as well as factors affecting their interaction. This is to assist with the development of more effective instructional strategies and better use of the technology. There are several different methodologies that have been used to provide evidence of online meaning-making. Research into online discussions has drawn, not surprisingly, on similar sources of evidence: online questionnaire survey, interviews and message analysis. Some researchers have adopted more recognisably ethnographic perspectives (Taylor, 2001), while others have used experimental and comparative methods (Koory, 2003; Weller, 2000). Indeed, others have been inspired directly from areas of discourse analysis in general such as critical discourse analysis (Fairclough, 1993). Fairclough bases his methodology on the multifunctional linguistic theory of Halliday's functional-systematic linguistics (Halliday 1978, 1985). As we shall see later, the tension between language as socially determined and socially constitutive comes to the fore once analysis of computer-mediated communication tries to take into account language as language use, or the social context to language usage. Another approach, has been to adopt a more structured analysis of the chat, synchronous communication. Holmes (2008) proposes a discourse structure analysis (DSA) which provides both a quantitative and qualitative analysis of the online exchanges, he explores such issues as turn-taking and discourse coherence.

Many CMC researchers argue that one of the most powerful methods of investigation is content analysis of conference transcripts, and a range of seminal research studies over a decade exists as testament to this (Donnelly & Gardner (2009). Content analysis has provided these researchers with a direct means to understand the processes of learning and teaching, the quality of interactions, and the relationship between interaction and knowledge construction. Despite the perceived benefit of having large volumes of conference data readily available to researchers through the tracking mechanisms in virtual learning environments, recurring criticisms of this method are the lack of a reliable model of content analysis. A number of instruments of content analysis have been developed from a social constructivist perspective (Weinberger & Fischer 2006). Within these instruments for content analysis the unit has ranged from message, to thematic unit, to sentence and complete discussion. Moreover, the validity and theoretical foundation of the majority of instruments available for content analysis have been called into question (De Wever, Schellens, Valcke, & Van Keer, 2006). The discourse analysis of discussion boards in higher education has been closely associated with semantic analysis. The content, whether it be the sentence, the theme or the overall utterance (posting, or overall discussion) is closely related to the generation of new meanings. At a basic level, this would indicate that if students have adopted the semantics, the terminologies, then they have integrated the new concepts, and the learning has taken place. The analysis of large amounts of data available to tutors has led to the development of automatic language treatment software packages where the interaction of students can, for example, be represented visually (Holmes, 2008). Learning management systems have been given advanced tracking functionalities which include not only numbers of postings but also detailed data about pages visited and time spent. Early analysis of computer-mediated communication using asynchronous tools tended to focus on more

quantitative analysis of the data, focusing primarily on word counts and numbers of postings. Nonetheless, this means of analysis gives an initial good overview of the interactions which are taking place online but does not take into account the content of what is posted on the discussion boards. The analysis of the content of the discussion boards, therefore, moved towards a more semantic labeling of content or propositions. For, example, Campos (1998) gives a detailed formal semantic means of analysis whereby each proposition is qualified in terms of specific typology of discourse, i.e. affirmation, negativity, response. This semantic labeling is based on formal semantics which breaks down content into 'if and then' clause structure. Once the semantic labeling of the content has been carried out the analysis knowledge construction can take place. The co-construction of knowledge is evidenced from the use of propositions and based on conditional reasoning. This methodology demonstrated that new meaning was being created through the advances in the 'if and then' structures present on the discussion boards. Ravenscoft (2000) focused on the use of argumentation structure of the discussion boards; this analysis enables a clear labeling of content in terms of new argument and counter argument. Another means of semantic labeling has been inspired by a cognitive approach to what learning is, the co-construction of knowledge is evidenced through the acquisition of certain metacognitive activities online. The levels of cognition are labeled in terms of semantic propositions, the propositions contain new concepts or new ideas which are expressed, and the new proposition can in turn be taken as evidence of learning.

Content analysis, therefore, is inherently linked to the analysis of new meaning-making. One of the most interesting issues in this field is online meaning-making, specifically where and how it happens. The design of online formal learning spaces should enable us to glimpse the learning which is taking place online. However, the meaning-making which is present in online discussion fora, through analysis, is quite different to what is expected. As far back as the late 1990s, studies such as that by Gunawardena, Lowe, and Anderson (1997) attempted to find appropriate interaction analysis techniques that assist in the examination of the negotiation of meaning and co-construction of knowledge in CMC environments. The nature of the online dialogue between student/student or student/tutor raises some fundamental questions about the structure of asynchronous discussion for education. The meaning-making which is hoped for or evidenced tends to have taken place outside the formal learning space. For example, sometimes the discussion board is used to provide evidence for the tutor of the learning expected and students have subverted the formally designed online learning space and communicated with each other by other means outside the view of the learning management system through MSN or Skype or quite simply by SMS and telephone (Fitzpatrick et al., 2009).

There is, perhaps, an over-emphasis placed on the quantitative data extracted from the virtual learning environments which has a tendency to become a panopticon; an all-seeing, powerful, observing presence in the learning process (Land & Bayne, 2005). When examined in detail, the nature of the interlocution taking place online tends to have awareness of the educational panopticon's presence. Students, just as in face-to-face classroom situations, are aware that their performance is being scrutinised for evidence of learning. In the online environment the interaction becomes, in some cases, an evidencing of knowledge construction rather than knowledge construction itself. The *duologue* between the students could be compared to a dialogue on stage where the ever-present audience is the ultimate addressee rather the characters on stage. There is a triad of communication, student–student–tutor, the silent partner in this case being the tutor whose presence is constantly being acknowledged. Advances in pragmatic linguistics have led to a detailed analysis of this triad of communication, how the addressee and the duologue can be different in the exchange. In French pragmatic linguistics (la linguistique d'énonciation) interlocution is an area of research in itself and has been providing a very interesting analysis of dialogue, duologue, and triad in the theatre (Fitzpatrick, 2008). The

analysis of the online interlocution should not be simply reduced to quantitative data about the number of postings, number of thematic units, number of sentences, nor the number of utterances in the exchanges on the virtual learning environment. Coupled with the intensity of time and labour required to organise the volume of data, identify an appropriate unit of analysis and code the transcripts into suitable categories, the whole process leaves this as out of favour for many practitioners. However, with advances in the field of computational linguistics there are a number of automatic methods available which enable content coding to be done. Nonetheless, even with these advances, the language analysis tends to be based on more formalised parsing structures which label content as specific units of meaning but do not take into account the wider communication context of the online interactions. There have been developments in the analysis of multimodal communication techniques which focus on behaviour and linguistic expression at the same time. The analysis needs to include aspects of the communication which are intimately linked to the medium of communication which is being used.

The Pragmatics of Online Communication

In terms of computer-mediated communication, advances within the field of pragmatic linguistics have important consequences. Pragmatic linguistics is considered as a part of sociolinguistics where the focus is on the social use of language. Pragmatics focuses on the use of language and hence upon the context of language usage. In the methods briefly mentioned above, there is no mention of the context of the utterances under analysis and yet in terms of human computer interaction, it is this context that is lacking. The paralinguistic features of language or context, linguistics would argue, give meaning to the utterances. The analysis of the discussion needs to take into account the context, both in the sense of physical context but also in terms of educational context. In the area of research of CMC there has been a recent growth of interest in terms of methodologies which take into account the context of the discussion taking place. It has been shown that there is a higher frequency of pragmatic errors in CMC communication than there is elsewhere. The forms of presence online have a direct influence upon this; for example, if the addressee and addressor know each other, have spoken to each other previously then the grounding of the online communication can be more easily established. The lack of visual clues, tone of voice have all been analysed in earlier research which tended to focus on the comparisons between face-to-face communication and online communication. With recent developments in pragmatics, the areas of research have included grounding, theory of mind, multimodal analysis of exchanges. The context of the use of language is therefore of primal importance for a pragmatic linguistic analysis of the discussion boards. Indeed, even in terms of the co-construction of meaning, the establishment of context through the simple question about who is being addressed, or put more simply, who is talking to whom. The discussion does not take place without context – context here is meant in the wider sense of physical embodiment of language and educational context of the online communication. One of the fundamental principles of pragmatic linguistics is to investigate the wider context of the utterance, to juxtapose what is said with what is meant, or the said and the unsaid or not needed to be said. The establishment of means of analysing language in terms of wider contextual meaning-making is the main focus of this approach to linguistic analysis.

Susan Herring has developed a specific methodology for online discourse analysis which is called computer-mediated discourse analysis (CMDA) and from a linguistic perspective there is an extension of analysis beyond content to include key features of computer-mediated discourse such as the online community (see Herring, 2004a, 2004b). The methodology is on the surface very similar to traditional types of content analysis that have been mentioned above, however, although the methodology is language-focused it allows the inclusion of aspects of communication or context which are specifically related to computer-mediated communication. In this way it enables the analysis of language which is related to the specific medium of

communication, related to the semiotics of online communication. For example, turn-taking in synchronous communication online can be influenced by specific features of the technology being used, i.e. the buffer or page renewal features. The lag in the conversation, which can be technical but also due to the physical speed of typing, can lead to over-talking and non-sequential turn-taking. In face-to-face communication, these would have specific inferred meanings. The pragmatics of the social use of language would indicate that we do not talk over each other as this would be considered as impolite or rude. However, in the online environment the turn could be considered as the overall thread of the discussion within which turn-taking rules would be adapted to the communicative context. Certain advances in technology have enabled these new pragmatic rules to be taken into account. For example in instant messaging, whether it be on MSN or on Facebook, when our interlocutor is typing their message we are given notice of the fact. This would be equivalent to signaling that it is going to be my turn to talk. For asynchronous communication the turn can be considered as each individual posting on the discussion board where more time is given for each turn to take place. Another feature of pragmatic analysis is sometimes referred to as grounding, of finding the common ground in the conversation, or being able to infer what is meant. Grounding in the widest sense includes complex notions of belief systems and theory of mind. The interlocutors need to understand the social context, and grounding is used for reference resolution. If our interlocutors are in the same geo-political space and reference is made to 'our president' then the addressee can infer which president is being referred to. In online communication grounding or reference resolution can pose specific challenges. The nature of online communication can put speaking subjects in communicative situations who lack the certain grounding mechanisms to resolve simple references of the here and now. In online chat sequences the establishment of physical presence can at initial stages be very prevalent, where interlocutors refer to the time and distance present in the communication and refer to their own physical environment through references to the weather and such. In Herring's model of CMDA therefore we are given the possibility of including these specific features of online pragmatics into the analysis of the discussion boards.

Social Interaction, Collaborative Learning Tools

Interaction in education is a complex phenomenon. Online interaction as a means of communication is one of the most widely researched issues in higher education today. Donnelly (2008) argues that interaction has been and continues to be one of the most hotly debated constructs in the realms of distance and e-learning. The literature identifies several taxonomies that classify various types of online interactions. However, Moore's (1989) seems to be the most well-known taxonomy in the field of online education. He described three types of interaction: learner–content, learner–instructor, and learner–learner; these were later extended by Hillman, Willis, and Gunawardena (1994) to include learner–interface interaction. There is little doubt in the literature that social interaction is one of the most important components of the learning experience premised on social constructivist principles (Picciano, 2002). Interaction, using language as a tool of mediation among a community of learners, becomes a social mode of thinking where students learn by engaging in dialogue.

From a constructivist viewpoint, studies on web-based learning environments have shown that a critical component to interaction online is this interpersonal, social component; this occurs when learners receive feedback from the instructor or peers and colleagues in the form of personal encouragement and motivational assistance. Social interaction can contribute to learner satisfaction and frequency of interaction in an online learning environment. Indeed, Grabinger and Dunlap (2000) have reported that without the opportunity actively to interact and exchange ideas with each other and the instructor, learners' social as well as cognitive involvement in the learning environment is diminished.

For the purposes of this chapter, interactions are defined as reciprocal events that require at least two objects and two actions. Interactions occur when the objects and events mutually influence one another. A number of schools of thought have emerged in the last two decades that explore interaction in the context of technology-mediated learning. There are two commonly held beliefs. Firstly that the perceived quality of a learning experience is directly proportional to and positively correlated with the degree to which that experience is seen as interactive. Secondly, if technology-mediated learning designs are to have any significant impact on current and future pedagogical practices, then learning design decisions need to maximise the benefit of interaction.

Interaction has long been regarded as the vital ingredient upon which success depends in technology-related education. Research studies by Frankola (2001) and Charp (2002) on attrition rates in online courses have provided a rationale for the emphasis on promoting interaction and sound instructional strategies in online courses. More recently, Yun (2005) has concluded that there is evidence that instructional strategies which incorporate various types of interaction can be the key to teaching a high-quality online course that engages students. Student perceptions also provide a reason why interactivity is important in e-learning. A number of studies have shown that students tend to judge a distance education course according to their perception of the instructor–student interaction (Abbey, 2000; Flottechmesch, 2000; Lynch, 2002).

According to Vygotsky's social development theory (1978), learning does not happen in isolation. A number of respected scholars including Ramsden (1988), Garrison (1990), and Wagner (1994) have reported that increased levels of interaction have been shown to increase motivation, positive attitudes toward learning, higher satisfaction with instruction, deeper, more meaningful learning and higher achievement. Owston, Garrison, and Cook (2006) believe that 'sustained interaction between and amongst tutor and students leading to knowledge construction and validation requires an opportunity to share and test ideas in a secure environment and with a manageable number of students' (p. 339). Information and communication technologies have both the capability of supporting and enhancing this engagement and the capacity to extend the learning experience to critically consider the technology itself and critically access and evaluate the wealth of information available in a virtual learning environment.

The explosion of internet communication tools over the last 10 years has enabled the creation of new forms of interaction such as virtual learning environments, learning management systems, and, more recently, blogs and wikis, all of which have changed the way interaction is taking place. Asynchronous forms of communication have advanced with the development of Web 2.0 tools; asynchronous communication now extends well beyond the use of discussion boards and includes a number of means of collaboration. Web 2.0 tools have changed the nature of the internet from *publication to participation* (Warschauer & Grimes, 2008) or from *linking pages to linking people* (Wesch, 2007). Warschauer and Grimes present a very interesting analysis of an emerging semiotics of these new means of online communication, which are at the same time tools of communication and tools of collaboration. Initially the internet was a static space, where webpages could be created by the few people who knew how to create and publish HTML pages. The second generation internet enables millions of people to create webpages together through blogs and wikis. In terms of the classification of CMC these new forms are challenging, they are both asynchronous and synchronous forms. The forms of CMC have become more fluid and mixed. Web 2.0 social networking sites (for example Facebook) enable members to be informed when they are online, the distinction is becoming more and more challenging to uphold. Wikis such as pbwiki have seen a massive increase in usage. The use of wikis is already having an impact in higher education, where participants can share the creation of online webpages and documents. Wikis, in particular, are lauded as exemplifying social constructivism, where, for example one study in *Nature* magazine purported that Wikipedia was as accurate as or slightly

less accurate than the Encyclopedia Britannica (Giles, 2005). The collective knowledge construction which is taking place at a rapid pace online is challenging traditional notions of expert and expertise. The very notion of the university and traditional academe will ultimately be challenged by the egalitarian nature of Web 2.0 technologies. The post-structuralist collaboratively written, multi-authored text, raises questions about the role of the author and the role of the audience. The traditional boundaries between authorial intention and reader's receptive hermeneutics are becoming more and more blurred. At a more philosophical level, these new forms of interaction are calling into question the well-demarcated notions of authorship and reader. The technical advances of computer-mediated communication tools and collaboration tools are presenting challenges to what writing and reading are.

CONCLUSION

This chapter has been ambitious in trying to put forward new pointers for such a wide field of research. However, there is a need to re-evaluate research which is ongoing into computer-mediated communication and claims of co-construction of knowledge. Although large amounts of data and a growing number of methodologies are available to us, there is a need to take into account the semiotics and the social context of these online dialogues. The case can be made through a more interdisciplinary approach to the issues being raised. Current research, for example, in pragmatic linguistics around interlocution enables the inclusion of certain specific traits of the communicative context of CMC. Stahl (2003) argues that the form of communication that appears in computer-mediated interaction 'has special requirements and needs its own theory of communication'. The nature of the medium being used to communicate with, whilst it has afforded immense possibilities for communication amongst tutors and students, and students amongst themselves, has also brought with it specific needs for a theory of online communication. In this chapter we have limited ourselves to the most widespread usage of CMC in higher education in Ireland with asynchronous communication on learning management systems. Higher education has yet to come to terms with the consequences of adopting the use of this means of communication on its courses. It remains a significant challenge to socially construct knowledge through a new medium of communication, within an area which has been traditionally conservatively hierarchical and academically protective of that same knowledge.

REFERENCES

Abbey, B. (2000). *Instructional and cognitive impacts of web-based education*. Hershey, PA: Idea Group.

Angeli, C., Valanides, N., & Bonk, C. (2003). Communication in a web-based conferencing system: The quality of computer-mediated interactions. *British Journal of Educational Technology, 34*(1), 31–43.

Aviv, R., Erlich, Z., Ravid, G., & Geva, A. (2003). Network analysis of knowledge construction in asynchronous learning networks. *Journal of Asynchronous Learning Networks, 7*(3), 1-23.

Baron, N.S. (2008). *Always on: Language in an online and mobile world.* Oxford: Oxford University Press.

Belz, J.A., & Kinginger, C. (2002). The cross-linguistic development of address form use in telecollaborative language learning: Two case studies. *The Canadian Modern Language Review/La revue canadienne des langue vivantes, 59*(2), 189-214.

Benveniste, E. (1971). *Problems in general linguistics* (trans. Mary Elizabeth Meek), 2 vols. Coral Gables, FL: University of Miami.

Berge, Z.L. (1995). Facilitating computer conferencing: Recommendations from the field. *Educational Technology, 35*, 22-30.

Boghossian, P. (2006). *Fear of knowledge: Against relativism and constructivism*. Oxford: Oxford University Press.

Campos, M. (1998). Conditional reasoning: A key to assessing computer-based knowledge-building communication processes, *Journal of Universal Computer Science, 4*(4), 404-428.

Charp, S. (2002). Wireless vs. hard-wired network use in education. *T.H.E. Journal, 29*(8), 8-10.

Conole, G., & Oliver, M. (Eds.) (2007). *Contemporary perspectives in e-learning research: Themes, methods and impact on practice*. Abingdon: Routledge.

Curtis, D., & Lawson, M. (2001). Exploring collaborative online learning. *Journal of Asynchronous Learning Networks, 5*(1), 21-34.

De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcriptions of online asynchronous discussion groups: A review. *Computers and Education, 46*(1), 6-28.

Donnelly, R. (2008). Activity systems within blended problem-based learning in academic professional development. *International Journal of Applied Educational Studies, 3*(1), 38-59.

Donnelly, R., & Gardner, J. (2009). Content analysis of computer conferencing transcripts. *Journal of Interactive Learning Environments*, *20*(4), 469-485.

Fairclough, N. (1993). *Critical discourse analysis: The critical study of language*. New York: Longman.

Feurzeig, W., Munter, P., Swets, J., & Breen, M. (1964). Computer-aided teaching in medical diagnosis. *Journal of Medical Education, 39*(8), 645-754.

Fitzpatrick, N. (2008). *Les Je(ux) de discours dans l'oeuvre de Brian Friel*. Lille: CNT.

Fitzpatrick, N., Hayes, N., & O'Rourke, K.C. (2009). Beyond constriction and control: Constructivism in online theory and practice. In C. Payne (Ed.), *Information technology and constructivism in higher education: Progressive learning frameworks*. Hershey, PA: IGI Global.

Flottechmesch, K. (2000). Building effective interaction in distance education: A review of the literature. *Educational Technology, 40*(3), 46-51.

Foucault, M. (1966). *The order of things: An archaeology of the human sciences*. New York: Pantheon.

Frankola, K. (2001). Why online learners dropout. Retrieved August 30, 2005, from http://www.workforce.com/feature/00/07/29/

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Field Code Changed

Formatted: Font color: Auto

Garrison, D.R. (1990). An analysis and evaluation of audio teleconferencing to facilitate education at a distance. *The American Journal of Distance Education*, *4*(3), 13-24.

Garrison, D.R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7-23.

Giles, J. (2005). Internet encyclopaedias go head to head. *Nature*, *438*, 900-901 (December 15).

Grabinger, R.S., & Dunlap, J.C. (2000). Rich environments for active learning: A definition. In D. Squires, G. Conole, & G. Jacobs (Eds.), *The changing face of learning technology* (pp. 8-38). Cardiff: University of Wales Press.

Guevarra Enriquez, J. (2009). Discontent with content analysis of online transcripts. *Association for Learning Technology Journal, 17*(2), 101-113.

Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Halliday, M.A.K. (1978). *Language as social semiotic*. London: Arnold.

Halliday, M.A.K. (1985). *An introduction to functional grammar*. London: E. Arnold.

Ham, V., & Davey, R. (2005). Our first time: Two higher education tutors reflect on becoming a 'virtual teacher'. *Innovations in Education and Teaching International, 42*(3), 257-264.

Hammond, M., & Wiriyapinit, M. (2005). Learning through online discussion: A case of triangulation in research. *Australasian Journal of Educational Technology, 21*(3), 283-302.

Hawkey, K. (2003). Asynchronous text-based discussion: A case study with trainee teachers. *Educational and Information Technologies, 8*(2), 165-177.

Hendricks, V., & Maor, D. (2004). Quality of students' communicative strategies delivered through computer-mediated communications. *Journal of Interactive Learning Research, 15*(1), 5-32.

Henri, F. (1992). Computer conferencing and content analysis. In A.R. Kaye (Ed.), *Collaborative learning through computer conferencing: The Najaden Papers* (pp. 117–136). Berlin: Springer-Verlag.

Herring, S.C. (2004a). Computer-mediated discourse analysis: An approach to researching online behavior. In S.A. Barab, R. Kling, & J.H. Gray (Eds.), *Designing for virtual communities in the service of learning* (pp. 338-376). New York: Cambridge University Press. Preprint. Retrieved April 26, 2009, from http://ella.slis.indiana.edu/~herring/cmda.pdf

Herring, S.C. (2004b). Content analysis for new media: Rethinking the paradigm. In *New research for new media: Innovative research methodologies symposium working papers and readings* (pp. 47-66). Minneapolis, MN: University of Minnesota School of Journalism and Mass Communication. Retrieved April 26, 2009, from http://ella.slis.indiana.edu/~herring/newmedia.pdf

Herring, S.C. (2007). A faceted classification scheme for computer-mediated discourse. *Language@Internet*, 4, Article 1. Retrieved April 26, 2009, from http://www.languageatinternet.de/articles/2007/761

Hillman, D.C., Willis, D.J., & Gunawardena, C.N. (1994). Learner–interface interaction in distance education: An extension of contemporary models and strategies for practitioners. *American Journal of Distance Education, 8*(2), 30-42.

Hiltz, S.R., Coppola, N., Rotter, N., & Turoff, M. (2000). Measuring the importance of collaborative learning for the effectiveness of ALN: A multi-measure, multi-method approach. *Journal of Asynchronous Learning Networks, 4*(2), 103-125.

Holmes, T. (2008). Discourse structure analysis of chat communication. *Language@Internet*, 5. Retrieved October 26, 2009, from http://www.languageatinternet.de/articles/2008/1633

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Deleted: –

Field Code Changed

Formatted: Font color: Auto

Deleted: –

Formatted: Font color: Auto

Deleted: –

Deleted: –

Formatted: Font color: Auto

Holmes, B., Tangney, B., FitzGibbon, A., Savage, T., & Mehan, S. (2001). Communal constructivism: Students constructing learning for as well as with others. Retrieved December 5, 2006, from https://www.cs.tcd.ie/publications/tech-reports/reports.01/TCD-CS-2001–04.pdf

Jonassen, D.H., & Reeves, T.C. (1996). Learning with technology: Using computers as cognitive tools. In D.H. Jonassen, (Ed.), *Handbook of research on educational communications and technology* (pp. 693-719). New York: Macmillan.

Koory, M.A. (2003). Differences in learning outcomes for the online and f2f version of 'an introduction to Shakespeare'. *Journal of Asynchronous Learning Networks*, *7*(2), 18-35.

Koschmann, T. (Ed.) (2001). *CSCL: Theory and practice of an emerging paradigm* (pp. 1-23). Mahwah, NJ: Lawrence Erlbaum.

Land, R., & Bayne. S. (Eds.). (2005). *Education in cyberspace*. London and New York: RoutledgeFalmer.

Levy, S. (1984). *Hackers: Heroes of the computer revolution*. New York: Dell.

Lynch, M.M. (2002). *The online educator: A guide to creating the virtual classroom*. New York: RoutledgeFalmer.

Macdonald, J., & Twining, P. (2002).Assessing activity-based learning for a networked course. *British Journal of Educational Technology, 33*(5), 603-618.

McConnell, D. (2000). *Implementing computer supported cooperative learning* (2nd ed.). London: Kogan Page.

McConnell, D. (2006). *E-learning groups and communities*. Maidenhead: Society for Research into Higher Education & Open University Press.

McFerrin, K.M. (1999). Incidental learning in a higher education asynchronous online distance course. In J.D. Price, J.Willis, M. Jost, & S. Boger-Mehall (Eds.), SITE 99: Proceedings of the Society for Information Technology & Teacher Education International Conference (pp. 1418-1423). San Antonio TX, 28 Feb. to 4 Mar. (Charlotteville, VA: Association for the Advancement of Computers in Education (AACE)).

Moore, M. (1989). Editorial: Three types of interaction. *The American Journal of Distance Education, 3*(2), 1-7.

Murray, D. (1985). Composition as conversation: The computer as a medium of communication. In L. Odell & D. Goswami (Eds.), *Writing in non-academic settings* (pp. 203-227). New York: The Guilford Press.

Owston, R., Garrison, D., & Cook, K. (2006). Blended learning at Canadian universities: Issues and practices. In C.J. Bonk, & C.R. Graham (Eds.), *The handbook of blended learning. Global perspectives, local designs* (pp. 338-350). San Francisco: Pfeiffer.

Picciano, D. (2002). *Educational leadership and planning for technology* (4th ed.). Columbus, OH: Prentice Hall.

Ramsden, P. (1988). *Improving learning: New perspectives*. London: Kogan Page.

Ravenscoft, A. (2000). Designing argumentation for conceptual development, *Computers & Education*, *34*, 241-255.

Resnyansky, L. (2002). Computer-mediated communication in higher education: Educators' agency in relation to technology. *Journal of Educational Enquiry*, *3*(1), 35-58.

Rheingold, H. (1993). *The virtual community: Homesteading on the electronic frontier*. Reading, MA: Addison-Wesley.

Stahl, G. (2003). *Communication and learning in online collaboration*. Paper presented at GROUP_03, Sannibel Island, Florida. Retrieved April 26, 2009, from http://www.cis.drexel.edu/faculty/gerry/publications/conferences/2003/group/group03.doc

Taylor, S. (Ed.) (2001). *Ethnographic research: A reader*. London: Sage.

Formatted: Font color: Auto
Deleted: –
Deleted: –
Deleted: –
Deleted: ,
Deleted: –
Deleted: .
Formatted: Superscript
Deleted: –
Deleted: –
Deleted: and
Deleted: –
Deleted: –
Deleted: .
Formatted: Superscript
Deleted: –
Deleted: –
Formatted: Font color: Auto

Thomas, M.J.W. (2002). Learning within incoherent structures: The space of online discussion forums. *Journal of Computer Assisted Learning*, *18*, 351-366.

Thorne, S.L. (2006). Pedagogical and praxiological lessons from internet-mediated intercultural foreign language education research. In J.A. Belz, & S.L. Thorne (Eds.), *Internet-mediated intercultural foreign language education* (pp. 2-30). Boston, MA: Heinle & Heinle.

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner and E. Souberman, Trans.). Cambridge, MA: Harvard University Press.

Wagner, E.D. (1994). In support of a functional definition of interaction. *The American Journal of Distance Education, 8*(2), 6-29.

Warschauer, M. (1996). Computer assisted language learning: An introduction. In S. Fotos (Ed.), *Multimedia language teaching* (pp. 3–20).Tokyo: Logos International.

Warschauer, M., & Grimes, D. (2008). Audience, authorship and artifact: The emergent semiotics of Web2.0. *Annual Review of Applied Linguistics*, 27, 1–23. Retrieved October 26, 2009, from http://www.gse.uci.edu/person/warschauer_m/docs/aaa.pdf

Weinberger, A., & Fischer, F. (2006). A framework to analyze argumentative knowledge construction in computer-supported collaborative learning. *Computers & Education*, *46*, 71–95.

Weller, M. (2000). The use of narrative to provide a cohesive structure for a web based computing course. *Journal of Interactive Media in Education*, 1. Retrieved, April 26, 2009, from http://www-jime.open.ac.uk/00/1/

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.

Wesch, M. (2007). Web2.0: The machine is us/using us [Video], Retrieved, April 26, 2009, from http://www.youtube.com/watch?v=6gmP4nk0EOE

Wilson, G., & Stacey, E. (2004). Online interaction impacts on learning: Teaching the teachers to teach online. *Australasian Journal of Educational Technology, 20*(1), 33-48.

Yates, S.J. (1996). Oral and written linguistic aspects of computer conferencing: A corpus-based study. In S.C. Herring (Ed.), *Computer-mediated communication: Linguistic, social and cross-cultural perspectives*. Philadelphia: John Benjamins Publishing Co.

Yun, K. (2005). Collaboration in the semantic grid: A basis for e-learning. *Applied Artificial Intelligence, 19*(9 & 10), 881-904.

ADDITIONAL READING

Goertler, S. (2009). Using computer-mediated communication (CMC) in language teaching. *Unterrichtspraxis/Teaching German*, *42*(1), 74-84.

Hull, D.M., & Saxon, T.F. (2009). Negotiation of meaning and co-construction of knowledge: An experimental analysis of asynchronous online instruction. *Computers & Education*, *52*(3), 624-639.

Land, R. (2004). Embodiment and risk in cyberspace education. In R. Atkinson, C. McBeath, D. Jonas-Dwyer, & R. Phillips (Eds.), *Beyond the Comfort Zone: Proceedings of the 21st ASCILITE Conference*. Perth, Western Australia, 5–8 December: ASCILITE. Retrieved April 26, 2009, from http://www.ascilite.org.au/conferences/perth04/procs/contents.html

Mäkitalo, K., Weinberger, A., Häkkinen, P., Järvelä, S., & Fischer, F. (2005). Epistemic cooperation scripts in online learning environments: Fostering learning by reducing uncertainty in discourse? *Computers in Human Behavior, 21*, 603-622.

Paulus, T.M. (2009). Online but off-topic: Negotiating common ground in small learning groups. *Instructional Science: An International Journal of the Learning Sciences*, *37*(3), 227-245.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences*, *3*(3), 265-283.

So, H.J. (2009). When groups decide to use asynchronous online discussions: Collaborative learning and social presence under a voluntary participation structure. *Journal of Computer Assisted Learning*, *25*(2), 143-160.

Zeng, G., & Shigenobu, T. (2009). Text-based peer-peer collaborative dialogue in a computer-mediated learning environment in the EFL context. *International Journal of Educational Technology and Applied Linguistics*, *37*(3), 434-446.

Deleted: –

Deleted: –

Deleted: –