Conflict Expressed Through Electronic Communication:
Ramifications for the Mediation Process

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Abstract

This paper will explore some of the key challenges to effective communication when a conflict is expressed through a means of telecommunication. Among the items discussed are tone, social cues, and speed of communication. Having presented some of the challenges in computer-mediated-communication, the discussion turns to the mediation process and ways of managing the process to encourage and facilitate more meaningful communication between the parties.

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Introduction

This paper will outline some of the key challenges in maintaining constructive telecommunication between parties experiencing conflict. A survey of professionals at addressing conflict, including mediators, human resource personnel, managers and lawyers was conducted. Although the number of respondents was insufficient to draw scientific results, the respondents of the survey highlight some communication challenges when communicating through any form of telecommunications. It is discussion and elaboration of these issues upon which this article is based.

Romiszowki (1997) coined the term 'computer-mediated-communication' which is defined as 'any form of organized interaction between people, utilizing computers or the computer network as mediums of communication.' For the purposes of this paper, electronic communication is defined as any non face-to-face communication, including but not limited to telephone conversations, email, instant text messages through mobile telephones and web-based applications, video-conferencing and internet telephone.

This paper will investigate how participants in an electronic communication negotiate with one another and how these negotiation strategies impact conflict, conflict formation and subsequent efforts at designing and implementing a suitable mediation process. The article is written from the perspective of an interest-based mediation process. In principle, the ideas, concepts and recommendations to the mediation process can be applied to a problem-based mediation, a transformative mediation or any other mediation process occurring in an online setting.

Conflict

Conflict, both non-violent and violent, can be defined as a difference of opinion between two or more parties. The disagreement between two or more parties is based on a difference of needs, interests or concerns. Schneider (2000) used Jacob's and Schreyer's (1980) definition in stating conflict is 'goal interference attributed to another's behavior.' LeBaron (2002) argued that conflict occurs on different levels, ranging from a difference over issues and material differences, to communication and social dynamics, to symbols, perceptions and identities. Starks (2006) described conflict as a behaviour that negatively impacts another individual or group. According to Starks, the negative behaviour or actions can be in the areas of 'beliefs, values, attitudes, ideas, needs, goals, perceptions, expectations, or interests'.

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Andrade, Plowman and Duchon (2008) presented Pondy's definition of conflict:

“Pondy (1967) was one of the early voices who tried to clarify the multiple definitions of conflict, and suggested that conflict is an episodic state of disorder that includes five stages-latent, perceived, felt, manifest, and aftermath. Latent conflict refers to the conditions or sources of conflict, such as scarce resources, need for autonomy and goal differences. Perceived conflict, that is, the awareness of conflict, can be present even when there is no latent conflict and vice versa. Felt conflict is the internalization of conflict. Manifest conflict is the resulting behavior, such as aggression, apathy, or rigid adherence to rules. Aftermath refers to the (new) conditions created as a result of the conflict, that is, more cooperation due to successful resolution or dissolved relationships due to lack of resolution.”

Pearson, Pearson and Griffin (2008) commented on the following in relation to the use of technology as a means of communication:

“Many factors, such as one's attitude toward applying existing technology in new applications, influence IT innovation by individuals (Fichman 2000; Venkatesh, Morris, Davis, and Davis 2003). Attitude is considered an antecedent of intention, which in turn, has been suggested to predict behavior (Fishbein and Ajzen 1975). The problem with intention, however, is that it can be swayed by perceptions of environmental obstacles, and these perceptions cause the individual's goal to become more difficult to obtain (Bagozzi and Warshaw 1990).”

In addition to the actual technology used to communicate, another important underlying factor in the communication is the overall level of trust or mistrust between the parties. The parties may know each other well and have a multifaceted relationship. The multifaceted relationship may be high or low trust. Conversely, the parties may have a narrow relationship in which their only contact is for the purchase of an item or specific work-related item. Narrow relations, or relationships in which there is only one or a few reasons to contact the other, are more prone to have lower levels of trust.

Role of Technology in Communication

'The single biggest problem with communication is the illusion that it has taken place’ ~ George Bernard Shaw

Tone of voice, facial expressions, increased prevalence of telecommunications thereby increasing the number of opportunities in which these types of misunderstandings can occur.

Bolliger (2009) presented communication preferences of two groups of students taking the same course offered through e-learning opportunities. In both sessions of the class, students initially focused on task-oriented communications. Once the task nearly complete, communication increasingly turned to social-communications. In these non-task oriented communications, posts with the most emoticons (graphics depicting an emotion), were the most active in terms of responses, participants and length of communication. Bolliger argued that emotions were in fact present during online communications, they are however expressed in a different way than in face-to-face communications.

9 Doris U. Bolliger. “Use of Patterns of Visual Cues in Computer-Mediated Communication,” Quarterly Review of
Byron and Baldridge (2007) found that receivers of emails intentionally search for cues in the content of the message. Byron and Baldrige focused on the use of capital letters and emoticons and their interpretation by the receiver. Byron and Baldrige found that extroverts were more likely to act upon positive cues in an email (emoticons, positive language and so on), than were introverts. As such, extroverts were more likely to describe the sender of an email as “likeable”. By contrast, introverts were more likely to pick up on ambiguous or unclear social or emotional cues, and negatively react to them, thus negatively influencing their perception of the sender's likeability. Byron and Baldrige found that appropriate use of capital letters reduces ambiguity. Byron and Baldrige concluded that personality differences in the receiver of emails must also be taken into consideration when interpreting the meaning and emotions of the sender's text.\(^\text{10}\)

The matter of introversion and extroversion does have an impact on conflict and of the perception of the conflict by the individual. Olsen Laney (2002) explained:\(^\text{11}\)

> “While some people (usually extroverts) thrive on seeing the sparks fly, other people (usually introverts) are conflict-adverse. They’ll do anything rather than face a fight. Conflicts use up their energy, and they go out of their way to avoid them. But ignoring them is generally a mistake. For one thing, the conflict doesn’t disappear.”

As with other forms of communication, conflicts expressed through online communication may involve one or more recipients that may be an introvert. In face to face conversations, a conflict may arise and an introvert may seek a conflict avoidance strategy. The behaviour of conflict avoidance may not be possible through online communications as it may be the only way by which the employees can communicate with one another, or the parties to the conflict are the only individuals who can address a specific situation. Conflict avoidance is not necessarily a good thing, though in some instances, conflict avoidance may be the preferred strategy. In specific reference to online communication and in some instances work relationships that are almost entirely done through online communications (employees that must communicate with employees at different locations, for example), the productivity, effectiveness and overall well being of individuals experiencing conflict through electronic communications may be reduced, particularly if they are introverts.

The issue of whether or not one of the parties in the electronic communication, in this case email, is liked, does have an impact on the negotiation strategy used. If, during the course of the electronic exchange, one of the parties is perceived as disliked, then the other party may adopt a more aggressive negotiation strategy. Friedman and Currall (2003) argued that a disliked party tends to receive more blame whereas a liked party is more likely to receive the benefit of the doubt.\(^\text{12}\) In terms of communication, one party who receives a message that is perceived to be hostile, may ask for clarification before assigning a value or a judgement to the counter-party, if the counter-party is liked. If the counter-party is disliked, the same message may be received with hostility or anger.

Again, the matter of a party to the conflict being an introvert or an extrovert arises. In a multiparty electronic communication, the parties that are display more extroversion may be more liked than

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\(^{12}\) Raymond A. Friedman and Steven C. Currall. “Conflict escalation: Dispute exacerbating elements of e-mail communication,” *Human Relations* 56(11):2003, 1330.
parties that appear to be more introverted. Although this dynamic is present in face to face conversations, this particular dynamic may be exacerbated due to the mode of communication. The more narrow the type of communication (lack of tone of voice, lack of visual cues, lack of body language, and so on), the greater the likelihood of a dispute or conflict developing.

Another aspect of communication in general, is how a person perceives the other. In a face to face communication, a person who is depressed, is schizophrenic or is alcohol dependent, may have difficulties accurately interpreting the facial expressions of the other person. This, translated into an online setting, in which there are no facial expression beyond emoticons, may further aggravate the miss interpretation of intent and overall emotional state of the counter-party.

In an online setting, it is imperative to seek clarification to determine whether or not a dispute or conflict is actually transpiring. A misunderstanding or a misinterpretation of a message may lead to a dispute or conflict. However, upon further communication if the misunderstanding of tone, intent, emotion or purpose of the message is clarified, there may not be a dispute or a conflict. The matter at hand may be a matter of perception and interpretation of the method of delivery of a message, rather than the actual content and intent of the message. Such a situation remains in Pondy's first state of conflict, that of perception. Once the perception is clarified with more accurate information, the dispute or conflict is resolved.

Friedman and Currall (2003) presented the dispute-exacerbating model of e-mail (DEME) in which they argued there are four differences in the method of communication through email that can increase the likelihood of a conflict escalating. Due to the format of the media, email offers less feedback during the communication [less opportunities for correction by the other party]. In addition to 'diminished feedback', Friedman and Currall, identified 'minimal social cues' as another concern with the method of communication through email. Email provides an opportunities for each party to write lengthy, well researched and sourced, texts to send to the other party. The length of the email, as well as the number of concerns or points one particular email contains, may it and of itself provoke anger in the counter-party(ies). The fourth category identified by Friedman and Currall is the amount of time a sender or receiver can spent reviewer the contents of a message. The longer a person spends on the content of one particular piece of information [one specific email in a series of correspondence], the more vested the individual becomes, and may become more aggressive or entrenched in their position.

**Communication Cues – Tone**

Du and Xu (2010) presented Tuckerman's typology in team forming:

“According to Tuckerman, team growth is a sequential and developmental process, including four stages in the following order: forming, storming, norming and performing. Each stage is characterized by two major dimensions: the task-related issues and peer relationship growth. (Tuckerman, 1965)”

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Rhea, Rovai, Ponton, Derrick and Davis (2007) researched the tone and emotions present during evaluations of the same course (content) given in two different ways: a face-to-face course and an online course. For the same course content, Rhea et al discovered that the students enrolled in the face to face course offered more constructive feedback in their evaluation of the course than those who participated in the online course. Moreover, the students in the online course phrased their feedback in harsher terms than the students in face to face courses.\(^{16}\) In a different study, Potter and Balthazard (2007) argued that the lack of social cues may lead to more accurate evaluations of others' work.\(^{17}\) Thus, the lack of face-to-face communication may be beneficial when having to make impartial assessments of a particular situation, work or team.

Another aspect related to computer mediated communication is the presence of 'flames', 'flame wars', also known as hostile or antagonistic forms of online communications. One party to an online communication may interpret a posting as hostile or antagonistic whereas the other party may not.\(^{18}\)

Although not always the case, some of the creation of 'flames' or 'flame wars' may arise from a situation known as 'disinhibition'. Gackebach and Stacklerg (2007) argued that the lack of visual cues in online discussion facilitated communication that is without judgements on the physical appearance or presence of the other. At the same time, the lack of physical presence of the other tends to allow for a more honest free flow of communication. It can prompt greater disclosure between individuals and may encourage the parties to divulge information that in a face to face setting could be considered inappropriate, too sensitive or otherwise too personal. Whilst internet communication may facilitate more open communication between the parties, through disinhibition, it may also facilitate the increased use of content, information, and interactions that are in the face to face world considered inappropriate.\(^{19}\)

Friedman and Currall (2003) argued that if email is used to mediate a conflict, participants must increase significantly their levels of self-awareness. As with other aspects of online communications, some perceived grievances or insults in an email, are not actually intended to be insults. The reader of the email must control their reactions more much, than in a face to face communication. Friedman and Currall argued that the participants need to monitor for increased aggression. Friedman and Currall also suggested that participants remind themselves that they will likely remain in a relationship with the other person. It is therefore important to include reminders of the broader relationship within the correspondence to ensure that the conflict itself, possible misinterpretations of the message, as well as other limitations of computer mediated communication, do not overwhelm the conversation. In reminding the participants of the broader relationship, the incidents of rising anger or hostility from misinterpreting email messages may decrease.\(^{20}\)

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Belkin (2009) argued that it is more difficult to create conditions in which relationships can be strengthened in an online setting. Belkin argued that organisations are emotional institutions in which the degree of positive or negative emotions felt by individuals had a direct impact on the outcome of a particular relationship, series of relationships (such as teams) and processes. Belkin stated further that the presence of emotional contagion in electronic communication has yet to be fully researched.\(^\text{21}\)

Barsade (2002) defined 'emotional contagion' as follows:

"This study focuses on emotional contagion, "a process in which a person or group influences the emotions or behavior of another person or group through the conscious or unconscious induction of emotion states and behavioral attitudes" (Schoenewolf, 1990: 50), in particular, the contagion of everyday moods in work groups."\(^\text{22}\)

Anger Elfenbein (2006) argued that teams with high levels of emotional intelligence performed better than teams without high levels of emotional intelligence. The success of emotionally intelligent teams comes from the ability of team members to share a positive mood with one another. In other words, effective teams have the ability to engage in positive emotional contagion.\(^\text{23}\) It is possible to engage in positive emotional contagion in an online setting. It is also possible to engage in negative emotional contagion in an online setting. The opportunities for negative emotional contagion, that is the sharing and spreading of negative feelings, possibly feelings related to a (perceived or real) conflict, may be greater in an online setting due to the limited information in the types of communication.

Emotional contagion can and does have a role in negotiations. Negotiators often engage in something called “emotional tuning”. Emotional tuning occurs when a negotiator constructs 'messages designed to control or regulate the other party's emotional response'. In addition, negotiators may also suppress emotional responses when emotional responses are deemed to be counterproductive.\(^\text{24}\)

Barry, Smithey Fulmer and Van Kleef (2004) cited studies in which a pre-mediation intentionally involved humour or intentionally did not. The pre-mediation sessions that involved humour increased the likelihood of the participants of a mediation to make concessions, as well as adopt a mixed-motive negotiation strategy. In other words, a mixed-motive negotiation is interest based as it explores ways of 'growing the pie', and each party then claiming an appropriate share of the larger pie.\(^\text{25}\)

Given that emotions have a direct role in conflict, as well as a role in setting up a mediation process, the impact of emotions in an online setting are equally important. In the context of this article, the conflict was formed during the course of online communications. Emotions and emotional contagion can quickly turn online communications into negative emotional experiences. For the purposes of this


\(^{25}\) Ibid. 76.
article, a conflict formed online is to be mediated through online communication.

**Communication Cues – Social Cues**

One concerned mentioned in the informal survey of conflict expressed through electronic means, is the lack of facial cues from both the sender and receiver. The loss of facial cues through electronic communication can be broadened to include the concept of 'social presence'. Social presence includes facial cues, posture, non-verbal behaviour of both sender and receiver, and the degree of attentiveness to the actual communication. The reduction of social presence (the reduction of social and behavioural cues) removes inhibitions to certain types of communication. As such, communication may become more positional and polarized. Potter and Balthazard (2007) argued that the lack of social cues may lead to more accurate evaluations of others' work.

Friedman and Currall (2003) presented Clark and Brennan's six tools for grounding. Grounding is a process in which the parties to an interaction gain 'a shared sense of understanding about a communication and a shared sense of participation in the conversation.' According to the Clark and Brennan model presented, the six tools or techniques used for grounding are i) co-presence allowing all parties to be in the same surroundings, ii) visibility allowing all of the parties to see one another, iii) audibility, allowing all the parties to hear one another, iv) co-temporality in which one party hears a sound as it is pronounced, v) simultaneity allowing both parties to both send and receive a message at the same time, vi) sequentiality in which the taking of turns can not get out of sequence.

"The lack of contextual clues (due to a lack of cotemporality and sequentiality) impose high ‘understanding costs’ on participants in e-mail interactions, making it harder to successfully ground the interaction, according to Clark and Brennan (1991)."

Other variables that factor into social cues, are pre-mediation contacts between the parties to a conflict. Thompson and Nader (2002), presented several pre-mediation scenarios. When the negotiations spoke with each other on the telephone prior to the commencement of the email negotiations, the parties to the email negotiations were more likely to adopt a cooperative negotiation strategy, meaning they were more likely to propose and discuss mutually beneficial (win-win) solutions. Men negotiating with other men in an electronic setting more likely to adopt an aggressive strategy in comparison to e-negotiations between men and women. Another key finding was that email negotiations between members of the same group tended to be more cooperative in nature than electronic communications between members from different groups.

**Communication Cues – Speed of Communication**

Another issue concerning electronic communication is the speed at which the communication can

27 Raymond A. Friedman and Steven C. Currall. “Conflict escalation: Dispute exacerbating elements of e-mail communication,” Human Relations 56(11):2003,1328.
28 Ibid. 1328.
29 Ibid. 1328.
occur. Although face to face communication occurs in real time, there are more sources of information available to the participants. The participants can judge the tone, body language, length and frequency of silences, as well as social presence of the speaker. Any misunderstandings or miscommunications can, in principle, be quickly clarified as one of the recipients can intervene immediately and ask for clarification. In electronic communications, rapid communication between parties can be almost real-time, as with the case with instant messaging services, however as Turnage (2007) referencing Baruch noted:

“The speed factor, for instance, can be considered a double-edged sword. Because of email's "shoot from the hip" quality, people can fire off a message without thinking about the consequences (Baruch, 2005).”

Ruth (2008) cited work by Grønning in which there is a 'paradoxes of emails'. Among the aspects of the 'paradox of emails', is that most employees do not know their company's policy of electronic communications, or if their company actually has a policy on electronic communications. In addition there is often a lack of training in how to use and word communications in an email. Ruth also noted Luke's research on how emails require different skills. For example, in a hard copy English language book, people read horizontally beginning from the left and working their way to the right. In contrast, in emails people read vertically scanning for specific words or clusters of words. The significant difference in reading patterns has a specific impact on how the users receive the message, derive meaning from its content and then formulate a response.

Ruth also cited a case study in which an employee was overwhelmed by the amount of emails received. In Ruth's article, one of the case studies cited an employee that received a significant amount of emails that were not pertinent to the employees' work. The sender of the email would frequently send to “all”, meaning “all” email users on their network. This would often overwhelm people with email messages that were not directed at them, or had nothing to do with their work. Often emails are deleted without being read. The dearth of non verbal communication and cues is sometimes replaced by overwhelming amounts of information, in this instance emails.

**Mediating in an Online Setting**

Given that there are many variables involved in an online setting that are not necessarily factors in a face to face setting, the nature of the pre-mediation will likely have to be adapted to accommodate for communication changes. Prior to moving forward with the mediation offered in an online format, the participants need to be mindful that it is highly likely that their electronic communications may be recorded or leave a record. An email or instant text message can be stored and reviewed at a later date. The ability to review previous communications can benefit the parties as they explore options however there are instances in which it is not desirable to have a written record. Moreover, in an online setting, the parties to a conflict may be in different jurisdictions and they may have different rights and legal obligations. Such matters must be addressed prior to moving forward with the mediation.

The pre-mediation session will continue to include private discussions with each of the parties about

33 Ibid. 125.
their perspective of the conflict and events pertaining to the conflict, as well as information about the process and procedures of the mediation.

The pre-mediation process will also likely need to include an assessment of each party's level of comfort with telecommunications and the specific platform (actual program or method of computer-mediated-communication) in use. In addition to assisting, possibly coaching one or more of the parties in how to use the technology, it may be necessary to assist the parties develop communication skills in both sending and receiving electronic content. As previously argued, introverts as well as individuals who are depressed, among other conditions, may interpret a neutral message as hostile or negative. The method of communication should not generate conflicts in and of itself.

The process of the mediation also needs to be better tailored to the method of computer mediated communication. The parties to the mediation may opt for a synchronous communication model, such as by live instant message service or by a voice over internet provider (like skype). The participants may also opt for an asynchronous communication model, such as email in which the parties to the conflict must wait for the counter party to formulate and send a response. If the method is asynchronous then some guidelines as to the frequency of response may also need to be crafted. A party that responds within one hour may take offence that the counter party has taken one day to respond.

An asynchronous approach can also help the parties frame and develop their response so as to refrain from using 'flames', or inappropriate content. Also, the amount of issues that can be raised in a response must be pre-determined. Some parties prefer addressing several items simultaneously, whilst others prefer addressing one issue at a time. During the series of correspondence between parties, additional matters and issues can be raised. If the parties agreed to address each matter separately, a running list that is accessible to all parties, of matters to be added in the mediation can be made. In such situations, how each item is prioritized needs to be further discussed and agreed upon before moving onto the next issue.

On the matter of time and time lag between the message that is sent and the response that is given, as previously discussed, the mediator may create a process in which the time delay between responses is sufficiently as to permit the mediator to directly intervene in the event of a 'flame' or otherwise potentially negative or hurtful comment. While the comment can not be taken back by the sender, the ability of the mediator to intervene and ask appropriate questions, may help reduce overall negative or hostile feelings in the mediation.

The mediator may decide to coach one or more of the parties in how they frame and word their communications. Notwithstanding matters of power and power imbalances, the personality traits of a party (or number of parties) may make them more likely to view a response as negative. The mediator may then need to assist the parties in asking clarifying questions, help the parties express their opinion in a non-aggressive manner, or otherwise empower the party(ies) to seek additional information and insight into their own interpretations of the communication as well as enhanced information about the counter-party (ies).

As the mediation process is agreed upon by the participants, given the medium of communication, it may be recommended to include some humour to open the mediation. Sharing a funny cartoon or some other light hearted story will introduce a more positive tone to the proceedings and may encourage greater cooperation between the parties.

The manipulation of time may be easier through electronic communications. Different electronic
communication means (email, instant messaging, voice over internet provider, and so on) have different speeds. An email or message on a forum takes longer to compose than one sentence placed on a social networking website. As such, the speed at which a dispute can unfold is also different. However, the speed difference can also be put to the advantage of a suitable mediation process. Some issues are extremely delicate or painful for participants and parties may need to take more time to fully express their experiences and grievances. Different means of electronic communication facilitate a wider range of communication possibilities.

The possibility of using different forms of electronic communication can also be discussed with the participants. Depending on the nature of the conflict (two party, multiparty, multi-issue), the participants may feel it more appropriate to discuss one issue via email and another issue in almost real-time instant messaging or live-chat format. If the parties live in different time zones and a real-time chat is not possible, possibly other forms of electronic communication are possibly including shorter text messages through an instant messaging service, instead of a long email.

As previously argued, reminding the parties to a conflict of their broader relationship may help reduce negative emotions and perceptions of the other. Although it is not always appropriate for the parties to a conflict to enhance their relationship, in workplace settings, it may be appropriate for the parties to engage in other forms of non-mediation communication. For example, the parties may join their companies’ social networking platform, offering an avenues to expand and develop the relationship. If the relationship is extremely strained, secondary non-mediation channels can be reserved to share more positive and light hearted communications, such as sharing a cartoon or a joke.

**Conclusion**

Mediating a dispute or conflict through computer-mediated-communications can broaden the number of people and institutions that can benefit from alternative dispute resolution. At the same time, mediating in an online setting without being mindful of some of the challenges the different online settings have, can deepen the conflict, harm the parties or create secondary conflicts.

Prior to engaging in an online mediation session, the mediator must first get an appreciation for the general personality types of the parties involved. A formal personality test is not necessarily required, however getting to know the parties in the pre-mediation sessions offers mediators the opportunity to gain valuable insight into the person’s overall personality (introvert versus extrovert) and their overall levels of comfort with technology and communicating online.

Having spoken with the parties, the method of electronic communication needs to be determined. There are many different types of computer-mediated-communication, including voice over internet providers, emails, instant messages and bulletin boards. The parties may decide that certain aspects of the dispute or conflict are best addressed through voice over internet providers, whilst other aspects may be better addressed using emails. As the parties agree on a communication means, the process by which that communication means is used, must also be agreed upon. The specific computer-mediated-communication process will address how the parties will communicate with one another, frequency of contact, how to design and send emails (number of issues per email), time between correspondence, and so on.
Computer mediated communication and online mediation does offer opportunities for the parties to the conflict to broaden their relationships. There may be opportune moments for the parties to share light-hearted moments or explore other issues, thereby expanding their relationship and increases overall trust levels.

Computer-mediated mediation has the potential to be able to provide significant benefits to individuals involved in a dispute or conflict. As social cues, tone and other non-verbal communication is greatly reduced in online settings, the parties to the conflict, in cooperation with the mediator, must identify and implement a mutually agreeable process. Once a suitable process has been created, there are significant opportunities for trust building, relationship building and successful mediations.
References


Anna K. Tunage, “Email Flaming Behaviors and Organizational Conflict,” *Journal of Computer*