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Anonymity in classroom voting and debating

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Abstract

The advent of networked environments into the classroom is changing classroom debates in many ways. This article addresses one key attribute of these environments, namely anonymity, to explore its consequences for co-present adolescents anonymous, by virtue of the computer system, to peers not to teachers. Three studies with 16-17 year-olds used a vote-debate-vote scenario to explore in Study 1 (N = 59) anonymous, public or private voting with public oral debate; Study 2 (N = 79) anonymous, public or private voting with public written debate; and Study 3 (N = 84) anonymous or public voting and debating. Students were more likely to change their views after debate and show less convergence to group norms if voting anonymously. However, anonymous debate created an increased amount of off-task behaviour, but only at the beginning of the lesson. In general, anonymity was found to bring positive benefits to classroom argumentation.

Keywords: Anonymity; Argumentation; Computer-supported collaborative learning; Group processes; SIDE theory

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1. Introduction

Classroom practice in many areas involves students in argumentation. By so doing, it is hoped that students will learn to elaborate, reason and reflect upon their knowledge. Arguing in the classroom can help to make knowledge explicit, encourage students to change conceptions, build new knowledge and allow students to practice the skills of building effective arguments (Baker, 2004). However, research suggests that this form of collaborative argumentation is not always effective (e.g., Andriessen, 2006). Firstly, students need support in order to argue well. Too often, students produce malformed arguments, fail to link data to evidence, do not express their ideas clearly, nor evaluate contributions critically. Secondly, students can find it difficult to debate with one another if they worry about expressing their views or the impact of disagreeing with others. Thus, many researchers have considered if educational debates can be enhanced by the use of technology (Guiller, Durndell, & Ross, 2008; McAlister, Ravenscroft, & Scanlon, 2004; Veerman, Andriessen, & Kanselaar, 2000). There are many features of

electronic communication that may enhance argumentation including simultaneous access, persistence of representation, and structured templates. The purpose of the studies reported in this article is to analyse another facet of electronic communication – the possibility for learners to make their views known in a way that does not reveal their identity. Although this is a fairly obvious characteristic of online interactions where users are not co-present (e.g., in distance learning), the research reported in this article was aimed at testing the claim that providing anonymity within face-to-face co-present classroom settings facilitates students in expressing their views on a variety of issues and critically arguing and debating about them.

1.1. Anonymous debates

The way that anonymity can shape the process and outcome of debates has received considerable attention in both social psychology and group decision making. Anonymity is broadly defined as «the inability of others to identify an individual or for others to identify one's self» (Christopherson, 2007, p. 3040) and there is much evidence and agreement that it can radically change debate. However, there is much less agreement about whether this change is for good or for ill. A number of researchers emphasise the positive benefits. For example, Nunamaker, Briggs, Mittleman, Vogel, and Balthazard (1996) suggest that anonymity will encourage people to participate, reduce groupthink by evaluating ideas more objectively and consequently will lead to better ideas being considered. The Delphi technique (Linstone & Turoff, 1975) used in expert decision-making and forecasting relies on the anonymity of forecasts along with clear statements of initial positions and structured discussion to allow changes to these positions. Sia, Tan, and Wei (2002) found that group polarization (whereby people become more extreme in their thinking following debate) was increased when anonymised participants were co-present, although whether group polarization is seen as beneficial depends upon the context. Dubrovsky, Kiesler, and Sethna (1991) argue that it can equalise participation and influence for all group members irrespective of their social status. In contrast, other researchers suggest that it may encourage negative behaviour such as social loafing, free-riding, discount of contributions, reduce the formation of social relationships and increase bystander apathy (Christopherson, 2007; Kreijns, Kirschner, & Jochems, 2003). Postmes and Lea (2000) conducted a meta-analysis to explore if anonymity produces beneficial effects on computer-mediated group decision-making. They found no reliable benefit of anonymity on improved decision quality, number of ideas and solutions or satisfaction. But, they did find an increase in the number of remarks and the number of critical remarks.

From a theoretical perspective, classic theories of computer-mediated communication (CMC) such as Social Presence theory (Short, Williams, & Christe, 1976) or Reduced Social Cues (Kiesler, Siegel, & McGuire, 1984) suggest that anonymity should straightforwardly lead to decreased inhibition and so to less social comparison, less guilt and embarrassment and more 'flaming'. However, such theories have difficulty resolving the contradictory findings of anonymity research (Postmes & Lea, 2000). More recent theories advocate a more nuanced account. Thus, the Social Identity model of Deindividuation Effects (SIDE) (Lea & Spears, 1991; Postmes, Spears, & Lea, 1998) emphasises self-identity as situation specific rather than fixed and context

independent. In some contexts, one might categorize oneself as a unique individual but in others, in terms of memberships of specific social groups or wider social categories.

The SIDE model suggests that anonymity influences group behaviour through two fundamentally divergent processes, namely increased depersonalization and decreased accountability. Depersonalization refers to the tendency to see oneself and others as representative of social groups rather than as individuals (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Consequently, anonymity could lead to decreased self-awareness through deinviduation (Zimbardo, 1969) and to both self and others being perceived in terms of shared communalities and group concerns. Postmes and Lea (2000) argue that if a common identity is available that has clear implications for group behaviour then these groups' norms will have a stronger influence when anonymous than when identified. In the absence of a strong group norm or identity, depersonalisation is expected to have little effect. Alternatively, when a group member is anonymous, accountability should be reduced and so should the influence of the group. The individual no longer needs to fear reprisals from others for anti-normative statements and is liberated to respond how they so choose. Thus, they may take the opportunity to strategically criticise an opinion held by a high-status individual. In support of this theory, they conducted a number of studies where participants were visually anonymous and found that when group identity was primed more normative behaviour was displayed (Postmes, Spears, Sakhel, & de Groot, 2001). Evidence has also been found for the strategic aspects of the SIDE model whereby CMC can provide a way of enhancing social support, thus allowing members to resist a powerful out-group (Spears, Lea, Corneliussen, Postmes, & Ter Haar, 2002). Consequently, the SIDE model suggests a complex relationship between anonymity and behaviour in groups that in some situations would lead to more conformity to group norms and in others less. The factors that influence this include the way that anonymity is achieved, the social context, and the nature of the individual.

1.2. Anonymous educational debates

Compared to the wealth of research in decision making, social and organisational psychology, and CMC, anonymity has received relatively little attention in the field of learning and instruction. This would be unproblematic if this existing body of work had led to clear implications for education; however, given the range of factors that is now known to influence the impact of anonymity on debate, this is clearly not the case. The studies conducted in educational contexts have typically focused on online learning via forums and/or emails and have employed a case study method. For example, Chester and Gwynne (1998) conducted a case study with 20 students communicating (asynchronously) with instructors using a pseudonym. They describe enhanced participation and greater involvement but also that students reported feeling more aggression and one student in particular was disruptive and disinhibited. Similarly, McAteer, Tolmie, Duffy, and Corbett (1997) report positive responses from students who choose to participate in an online anonymous course but that many members of the class did not voluntarily contribute. Lea, Rogers, and Postmes (2002) designed a learning environment based upon SIDE that could be used to create anonymous interactions when it was important to foster group identity (i.e., early on) but identified interactions when not, and report positive findings. In one of a very few comparative studies in an

educational context, Tanis and Postmes (2007) compared CMC where participants were identified by a picture and a name to a condition in which no identity information was available. They found that in the anonymous conditions participants were more satisfied with their performance and the technology. In the related areas of peer assessment, again researchers suggest that anonymity is one of several factors that encourage student participation (Ballantyne, Hughes, & Mylonas, 2002; Topping, 1998, in press; Yang & Tsai, in press) and when electronic voting systems are used in lectures, students typically report that it is the anonymous nature of the response that encourages them to participate (Draper & Brown, 2004; Kennedy & Cutts, 2005).

It can be seen from this brief review that most of the research within educational context stresses the benefits of anonymity in contrast to the more mixed picture of research in CMC and social psychology. In general, educational research also tends to have higher ecological validity with participants engaging in CMC activities as part of a course but it also tends to confound anonymity with CMC in general rather than looking specifically at anonymous versus non-anonymous CMC. Consequently, the goal of the studies reported in this article is to keep the high ecological validity of much educational research but to systematically manipulate anonymity.

1.3. The present studies

The empirical research reported here consisted of a period of classroom observation followed by interviews with participating teachers and students. Three experiments were then conducted that addressed the impact of anonymity on students engaged in classroom debates which are preceded and followed by votes to capture opinions. Study 1 was concerned with the impact of anonymity on opinions (expressed as votes) prior and post a publically held oral debate. Study 2 replicated the design of Study 1 but vote and (written) public debates were conducted electronically. Study 3 manipulated the anonymity of the debate itself while maintaining voting in the background. Thus, each study had a distinct focus which changed as the studies progressed from the outcomes of argumentation through to the process of argumentation. A key methodological decision was to conduct this research within the constraints and opportunities of a real-world school setting. Choosing not to conduct the research in a laboratory setting made it impossible to randomly allocate participants to condition. However, we felt this implication was largely outweighed by the increase in external validity, as students were known to each other and the teachers chose topics and taught their normal classes in their standard settings. We will briefly describe the outcome of the classroom observation and interviews before turning in more detail to each of the experiments.

1.3.1. Classroom observation

Fourteen lessons by five teachers were observed by four of the authors of the present research; the lessons covered a range of topics and teaching methods. The researchers sat at the back of the class writing notes on the interactions and discussions involved in the classroom practices as well as recording the artifacts produced by the students. Materials used by the teachers such as books, hand-outs, electronic resources were archived. All notes were subsequently written up in a narrative form and discussed

within the team with the aim of identifying common themes, which led to the formulation of a number of claims on the nature of teaching and learning practices within the General Studies classes. These claims were backed up with specific episodes from the classroom observations. Subsequently, these claims were discussed with teachers. In addition, two focus group interviews were conducted with students studying A-Level General Studies: one from this cohort and one from a different college. These were structured around five main themes: overall impressions about General Studies; the nature of classroom discussion; small group discussion; individual work; and the role of technology.

Gelmini-Hornsby, Crook, Ainsworth, and O'Malley (2007) also reported on a range of these findings (e.g., perceived lack of resources, students' concerns about the ephemeral nature of the outcomes, lack of time for in-depth discussion) but one theme that was central for both teachers and students was problems in participation. Students and teachers felt (and classroom observation confirmed their impressions) that a few dominant students' voices led the classroom discussion. Once a position had been stated by such an individual, the other students felt either unable to offer an alternative position and simply agreed with this view or simply remained silent. Teachers felt frustrated that they were unable to find out the views of all the class so they could not encourage students with alternative views to contribute. It was this issue which led us to conduct the three following experiments to see if a voting system and specifically an anonymised voting system could overcome these problems.

2. Study 1: Classroom voting and debating

To be able to derive predictions for how anonymous voting will influence students' behaviour, it is necessary to consider the way that anonymity is achieved, the nature of the individuals involved and the context of the study (Postmes & Lea, 2000).

Anonymity is not a simple dichotomous variable but instead can be implemented in many different ways (Kahai, Avolio, & Sosik, 1998; Posmes & Lea, 2000). The participants in our studies were co-present rather than communicating at a distance (Sia et al., 2002). Source anonymity was implemented whereby participants knew the identities of others but not who was responsible for specific contributions. This can be contrasted with participant anonymity (or visual anonymity) where participants also do not know the identities of the other contributors (Kahai, 2009). The implementation was designed so that anonymity meant anonymous to peers but not to the class teacher. This variant was chosen based upon the interviews with staff and students as typically the teachers' role in facilitating discussion calls for them to know the identities of contributors and since students were concerned to hide their identities only from peers not teachers.

The participants in Study 1 were around 16 years old. Adolescents are known to be particularly influenced by the views of their peers compared to younger children or adults (Brown, 2004). For example, Steinberg and Monahan (2005) argue that students improve in the ability to resist peer pressure between the ages of 14 to 18 with little evidence for further development beyond that age. In addition, and in contrast to the vast majority of studies, our students were familiar with one another. They also knew they would stay in the classes for a complete academic year.

The context for the research reported in this article is classroom debates within the UK Advanced (A) Level General Studies courses. A-level examinations are

qualifications which students typically take as prerequisite to University courses. Around 60,000 UK students a year take General Studies, which aims to help students develop their critical and argumentation skills. It should be pointed out that General Studies is often compulsory for students (as it was in our studies) and our focus group interviews confirmed that many students do not value this course. Classroom debates differ from the decision-making ones where anonymity has typically been studied as they aim to explore cooperatively a range of arguments and viewpoints (Andriessen, 2006) and students are not aiming to achieve a consensual decision the group should implement. Consequently, educational debates normally end in a range of outcomes with participants holding many individual positions. The topic of the debate was the "Nature-Nurture Controversy", a lesson we had observed in the classroom observation in the previous year where it was clear that students held a range of opinions. In such debates, students discussed whether eight characteristics should be considered to be inherited (the "Nature" position) or acquired through culture (the "Nurture" position). The teacher provided students with a blank table to fill in (Figure1a) at the beginning of the lesson and then led the students through a 50-minute debate around the eight characteristics in turn. In Study 1, new ways of recording students' views were explored, that is, a voting system where students either revealed their views in public (Figure 1b) or anonymously (Figure 1c). The differences between these forms are summarized in Table 1. In addition, a second vote was added upon discussion with the teacher to allow students to reflect upon their positions after participating in the debate.

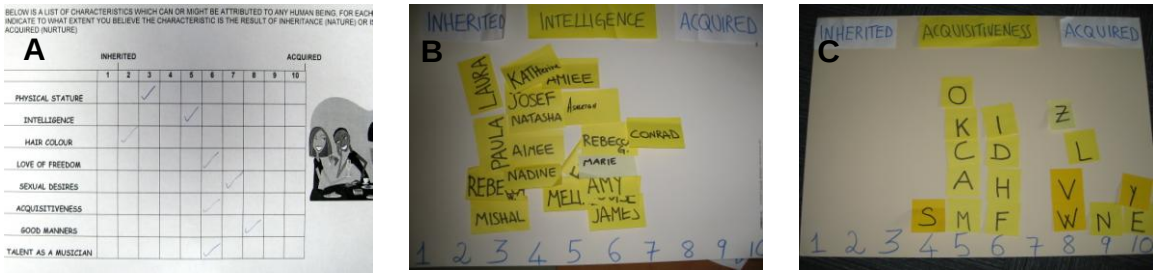

Fig. 1. Method of voting in the private, public and anonymous conditions. In Figure 1a, all characteristics are listed on the left hand side and in Figure 1b and Figure 1c, each characteristic is displayed in the centre. Votes are on a 1-10 scale anchored at inherited and acquired.

Table 1
Consequences of the different forms of voting

	Public	Anonymous	Private
One's vote revealed	Yes	No	No
One's vote shift revealed	Yes	No	No
Specific individuals identifiable	Yes	No	No
Class norms known	Yes	Yes	No
Can compare one's vote to norms	Yes	Yes	No

2.1. Hypotheses

Given the nature of the participants and context, as well as SIDE theory, it was predicted that students would not become significantly depersonalised under (source) anonymity as these participants were physically collocated and knew each other.

However, it was assumed that they would take advantage of the strategic aspect of anonymity when voting. This should allow them freedom to express opinions that may run counter to a prevailing group norm or the views of a dominant individual as they need no longer fear social evaluations. This was operationalised and measured in two ways: vote shift and deviation from norm.

Vote shift examines the absolute difference between the students' votes before and after debate and was summed over all eight topics. This variable is commonly used in group decision-making research to measure the impact of anonymity (where it is often called preference change) and is straightforwardly applicable to educational debates as it explores the extent participants changed their mind after the debate.

First and final deviation from initial norm examines the absolute difference between the students' votes and the median group position before the debate. Again, it was summed over the eight topics. These variables are similar to those used in group decision-making research, but differ in that such research is interested in the final decision and how much participants' initial decisions (expressed in private before the experiment begins) deviate from this final norm (often after multiple rounds aimed at achieving consensus). As there is no single decision in classroom argumentation, instead the focus was in how much students' final vote deviate from the initial norms. It was expected that classes where students feel free to express their opinion would show more deviation from the established norm. The first vote deviation was used to check that there were no unexpected differences between the classes prior to the intervention. Correspondingly, the specific hypotheses were the following:

Students who vote in public compared to those who vote anonymously or in private will not change their votes. As vote shift in both the anonymous and private condition cannot be identified by peers, these students should be more likely to change their votes (Hypothesis 1a).

Students who vote in public will be most influenced by the group initial norm and their votes will be more likely to converge upon this norm. Students in the private condition will be uninfluenced by the group norm as they are not made aware of it and so their votes will not converge upon this norm. Students who vote anonymously know the initial norm and how they compare to it, but also know that this information will not be revealed to others. Hence it was predicted these students would fall between the others (Hypothesis 1b).

2.2. Method

2.2.1. Design

Study 1 employed a 3 by 2 mixed design. The first factor, voting condition, was between groups and had three levels, namely private, anonymous and public. The second factor, time, was within groups and had two levels, namely Vote 1 and Vote 2.

2.2.2. Participants

All 59 participants were students studying A-level General Studies and were aged between 16-17 years. In total three classes were available to participate in this study and were all taught by the same male teacher. The classes were randomly allocated to one of the three conditions. The public voting class consisted of 15 female and 6 males, the

anonymous voting class had 9 females and 8 males and the private voting class had 11 females and 6 males (four students did not state a gender).

2.2.3. Materials

Students in the private condition received a pen and paper table (Figure 1a) that the teacher had used in previous years, listing eight characteristics and a scale on which students indicated the extent to which these are inherited (1) or acquired (10). This formed the basis for the design of the other conditions. The students were given one voting sheet at Vote 1 and a separate one for Vote 2, and they were asked to mark their vote on their sheet without conferring.

Students in the public class voted on their own personal sheet (as for private) and then transferred their vote to a public board by placing a sticker with their name on it against each characteristic (Figure 1b). Students in the anonymous voting class voted on their own personal sheet, and subsequently transferred their vote to a public board. They did so by placing a sticker with a letter code on it which only the individual student and the teacher could decode (Figure 1c).

2.2.4. Procedure

There were four main phases to the lesson. Phase 1 consisted of a short introduction to the topic of 'Nature-Nurture' and the eight characteristics to be debated. In Phase 2, students were asked to express their opinion about the degree to which they thought the eight characteristics were inherited or acquired (on a 10-point scale). The teacher then led a class discussion where each of these issues was debated one at a time (Phase 3). The students' votes were available to them as they debated the issues. The final phase was a second vote, where the students were called to express their opinion on each issue once again (without looking at their first vote) (Phase 4). All lessons took place in the participants' college and in their typical lesson slot (which was two hours in length with a 10-minute break in the middle).

2.3. Results

The vote shift measures the difference between the students' votes before and after debate (see Appendix A). Kruskal-Wallis test showed a significant main effect of vote condition, $\underline{H}(2) = 19.01$, $\underline{p} < .001$. Post hoc analyses revealed that students in the public condition ($\underline{Mdn} = 6$, $\underline{IQR} = 2.5\text{-}9.5$)[1] shifted significantly less than students in the private condition ($\underline{Mdn} = 8$, $\underline{IQR} = 0\text{-}1$), $\underline{U} = 142$, $\underline{p} < .05$, $\underline{r} = .31$,[2] and anonymous condition ($\underline{Mdn} = 15$, $\underline{IQR} = 6.5\text{-}23.5$), $\underline{U} = 26.5$, $\underline{p} < .001$, $\underline{r} = .73$. Those in the anonymous condition showed a greater amount of vote shift to those in the private condition, $\underline{U} = 93.0$, $\underline{p} < .02$, $\underline{r} = .41$.

Second, the impact of voting condition on how students' votes deviated from the initial norm (see Appendix A) was examined (see Table 2). As expected, condition did not influence students' first vote deviation, $\underline{H}(2) = .32$, $\underline{ns}$, however, it did influence the

[1] The interquartile range (IQR) is equal to the difference between the third and first quartiles.

[2] The $\underline{r}$ value is an effect size, that is, $\underline{z}$ / square root ($\underline{n}$), which is one of the commonly used non-parametric approaches to estimate effect size (Cohen, 1988). The following values are indicative of small ($\underline{r} = .10$), medium ($\underline{r} = .30$), or large ($\underline{r} = .50$) effect sizes.

final deviation, H(2) = 10.11, p < .01. Post hoc analysis showed that the public condition deviated significantly less from the initial norm than the anonymous, U = 108.0, p < .05, r = .33, and the private vote conditions, U = 100.5, p < .01, r = .47. There was no significant difference between the anonymous and private conditions, U = 141.0, ns.

Table 2
Median (and IQR) total deviation from the initial norm scores by vote condition in Study 1

	Vote condition		
	Public (n = 21)	Anonymous (n = 17)	Private (n = 21)
Vote 1 deviation	10 (4-16)	12 (5-19)	12 (5-19)
Vote 2 deviation	9(4.5-14.5)	12 (6.5-17.5)	13 (7-19)

2.4. Discussion

The students had a range of opinions about the characteristics, seeing some as more acquired and others as more inherited. For example, hair colour was seen as a mostly inherited characteristic and good manners as mostly acquired. Typically, students did not change their votes greatly after the debate. The minimum vote shift was zero and the maximum 24 (three per topic). However, given that the most common vote was 6 (on a 10-point scale) it was not possible for students to use a great deal of scale variability. Students in the anonymous condition showed the greatest difference between their first and second vote (at 1.75 per topic on a 10-point scale) which was significantly higher than both the public condition (at .75 per) and private (1.00). Therefore as predicted in Hypothesis 1a, and consistent with the SIDE model, students in the anonymous condition did take advantage of strategic aspects of anonymity to change their votes if they so wished.

Compared to students in the anonymous and private condition, students in the public condition showed the least deviation in their final vote (Hypothesis 1b). Once students in the public condition became aware of the other votes, it appears that if they did change their votes they did so in the direction of the norm (Sanders & Baron, 1977). Students voting anonymously were aware of the group norm (unlike in the private condition) but without the need to reveal their identity they were not compelled to conform to it and again could take advantage of this reduced accountability to the social group. As a result, their votes did not differ to students in the private condition. Anonymous voting in this study (source anonymous in a collocated situation with 16-year-old students who knew each other) seemed to have provided the optimal state. It allowed students the freedom to reflect their changes in opinion as a consequence of the debate and to do so in a way that did not lead to conformity to the prevailing group norm.

3. Study 2: Networked voting and debating

The aims of Study 2 were two-fold. First, it tested if the main findings concerning the benefits of anonymity would be replicated when the voting was conducted electronically. Second, it explored the relationship between students' vote and debate. Consequently, a networked environment was used both for the vote and for the debate (so the debate was textual not oral). The manipulation of the voting remained the same as for

Study 1, with votes occurring in private, in public and (source) anonymously. The debates condition was also kept the same as Study 1, that is, the debate was held in "public", with students' names associated with their written arguments.

Moving to a networked environment had a dual benefit. Networked environments have been specifically designed to overcome some of the problems of oral debates. They can help scaffold students' arguments by providing more structure, persistent representations (often in both text and graphics) of the debate and support parallel rather than sequential discussion (Andriessen, 2006). They are often preferred by students (Guiller et al., 2008). Classroom response systems are considered a beneficial way to quickly gather students' answers and views (Draper & Brown, 2004). Nunamaker et al. (1996) suggest that indeed the swift nature of electronic voting can change the activity from a single vote taken at one point in time to a repeated polling activity that can monitor emerging understanding. The second advantage is that networked environments allow researchers easy access to the research data as large group oral debates are difficult to record without obtrusive monitoring.

3.1. Hypotheses

The findings of Study 1 concerning the strategic benefits of voting anonymously were expected to be replicated by finding (a) students in the anonymous condition showing a greater degree of vote shift from the first to the second vote (Hypothesis 2a); and by finding (b) students in the anonymous condition showing the greatest deviation in their second votes from the initial norm (Hypothesis 2b).

The relationship between the vote and debate was also examined. The debates were all held in public so there was no "debate" condition (see Study 3) and so debating itself was not analysed. However, there is much popular concern that anonymity afforded by digital media leads to duplicity in communication (Caspi & Gorsky, 2006; Christopherson, 2007). In fact, support for this view is mixed with some researchers finding that CMC (email) decreases deception compared to face-to-face communication (Hancock, Thom-Santelli, & Ritchie, 2004). But there is some evidence that anonymity can increase deception in non-mediated situations (Diener, Beaman, Eraser, & Kelem, 1976). These apparently contradictory findings may be explained partly by the persistence of written text in emails and, thus, people may be held accountable for their deception; in contrast face-to-face communication is more ephemeral. In addition, in other contexts, people have a tendency to over-estimate the extent to which their internal (true) states may "leak out" in face-to-face contexts (cf. Gilovich, Medvec, & Savitsky, 1998). Consequently, it could be feared that due to the lessened accountability in the anonymous and private conditions, students make take strategic advantage of this situation to engage in deceptive communication. This was examined by assessing the extent to which participants' votes correspond to the arguments they made during the debate. Consequently, a third hypothesis predicted students who voted in public would be more consistent in their vote and debate behaviour than students who voted either anonymously or privately (Hypothesis 2c).

3.2. Method

3.2.1. Design

Study 2 employed a 3 by 2 mixed design. The first factor, voting condition, was between groups and had three levels, namely private, anonymous, and public. The second factor, time, was within groups and had two levels, namely Vote 1 and Vote 2.

3.2.1. Networked environment

Collaborative Face to Face Educational Environment (CoFFEE) is a freely available open-source suite of applications to support collaborative problem-solving discussions in the classroom (see www.coffee-soft-org.). Its main components are a series of tools for collaboration, shared work, individual work and communication and it consists of three linked applications, namely the CoFFEE Discusser, the Lesson Planner and the CoFFEE Controller (De Chiara, Di Matteo, Manno, & Scarano, 2007).

The CoFFEE Discusser is the learner's interface to the various debating tools. These include a graphical tool (a two-dimensional shared workspace based on a concept-mapping interface), a shared text editor with turn-taking, notes tools and simple SMS-style chat tools. The studies reported in this article used two tools, that is, a voting tool and a debating tool. The voting tool (called the PositionOmeter; see Figure 2) allows students to express an opinion by selecting a value from a (teacher-configured) scale. The Threaded Chat (Figure 3) uses a hierarchical, tree-like structure where each contribution is placed in the branch (thread) of the contribution to which it refers. Each topic has its own tree. Both these tools allow anonymity to be configured.

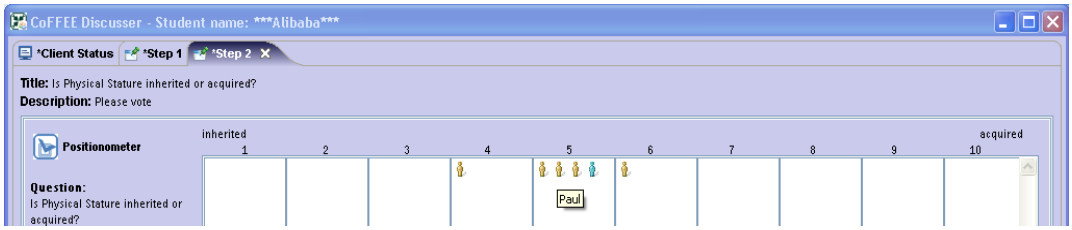

Fig. 2. PositonOmeter in CoFFEE (public condition).

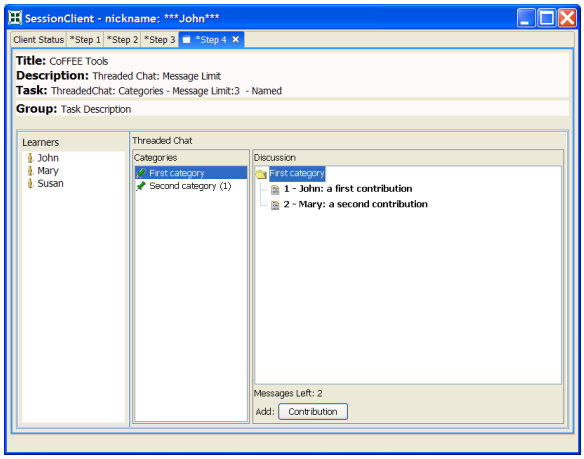

Fig. 3. Threaded chat tool in CoFFEE (public condition).

Teachers create lessons using the Lesson Planner. They can either adapt a pre-configured template or create everything from scratch in a Session Editor. The CoFFEE Controller is the teacher's runtime tool wherein teachers load lesson plans, and manage learners' interactions to monitor, facilitate or participate in the discussions.

3.2.3. Participants

All 79 participants were students of A-level General Studies and were aged between 16-17 years. In total five classes were available to participate in this study and were all taught by the same male teacher. Of the five classes, Class 1 (11 females and 3 males) and Class 3 (11 females and 6 males) participated in the public voting condition (n = 31); Class 2 (6 females and 9 males) and Class 5 (7 females and 7 males) participated the anonymous voting condition (n = 29), and Class 4 (15 females and 4 males) participated in the private voting condition (n = 19).

3.2.4. Materials

All voting and debating took place in CoFFEE with three different voting conditions implemented in the PositionOmeter. The private condition students only had access to their own vote in the PositionOmeter replicating almost exactly the experience of Study 1. The anonymous condition students could see which their vote was (indicated by a distinct colour) and what others voted but not the identity of the voters. Again this is almost identical to Study 1 where students knew their code but not those of others. In the public condition, students could reveal the identity of vote by rolling their mouse over others' votes. Arguably, this is a weaker instantiation that in Study 1, as then students' identities were automatically available (see the contrast between Figure 1c and Figure 2). The debate in threaded chat was held in public as the name of the contributor was placed at the beginning of the post. If anonymous, the name was simply deleted (i.e., no pseudonyms were used).

3.2.5. Procedure

All lessons took place in the participants' college in the IT suite. They were taught by their normal classroom teacher (with support from two of the authors). Again the topic was the 'Nature-Nurture Debate' debate. This time the voting and debating were in the CoFFEE environment. The lesson plan was identical to Study 1 with the exception that students received a ten-minute introduction to how to vote and debate with CoFFEE.

3.3. Results

One student from the anonymous condition failed to vote on all traits and was excluded from the analysis.

3.3.1. Vote results

Kruskal-Wallis test on vote shift revealed a significant effect of condition on vote shift, $H(2) = 6.99$, $p < .03$. Post hoc analyses found significant difference in vote shift between the private and anonymous conditions, $U = 144.0$, $p < .01$, $r = .39$, where the anonymous condition (Mdn = 13, IQR = 6-20) expressed a greater change in voting stance than the private condition (Mdn = 8, IQR = 2-14). There were no significant

differences in vote shift between the public (Mdn = 9, IQR = 0-18) and anonymous conditions, U = 351.0, p = .14, r = .19, and the public and private conditions, U = 227.0, p = .18, r = .19. Kruskal-Wallis tests were also conducted on the deviations from the norm values (see Table 3). As expected (Hypothesis 2b), condition did not influence students' first vote deviation, H(2) = .29, ns, but did influence students' final votes, H(2) = 13.07, p < .01. Post hoc analysis showed a significant difference between the public and anonymous vote conditions, U = 210.50, p < .01, r = .45, and the private and anonymous vote conditions, U = 147.00, p < .01, r = .38. There was no significant difference between the public and private conditions, U = 265.50, ns.

Table 3
Median (and IQR) total deviation from the initial norm scores by vote condition in Study 2

	Vote condition		
	Public (n = 31)	Anonymous (n = 28)	Private (n = 19)
Vote 1 deviation	12 (4-20)	11 (4.5-17.5)	11 (7-15)
Vote 2 deviation	10 (5-15)	14 (7.5-20.5)	10 (6-14)

3.3.2 Vote and debate results

The final set of analyses related to Hypothesis 2c and aimed to explore how the students' participation in the debate related to their voting behaviour (Table 4). In order to assess if anonymity would lead to participants expressing positions in the votes that were different to those expressed in the debates, we analyzed the congruity between their stated position and voting behaviour. For each of the eight characteristics, each participant's contribution to the debate was marked as to whether it stated that the feature was (a) inherited (e.g., "I dunno I think the ability to retain and retrieve information depends on your gene."), (b) neutral, that is, partly inherited and partly acquired (e.g., "It can be either. You can gain certain characteristics from your parents, such as being good at maths. ... Or if you have not very intelligent parents, you could work really hard to show that you're intelligent and than you can get something if you really try."), or (c) acquired (e.g., "Intelligence depends on if you wanna put effort in and learn it all really."). Contributions were not coded (30% of the total) if they could not be associated with a position or if a participant changed their position during a debate. In total, five participants were excluded from this analysis. This was then compared to the vote for that question (where 1-3 was inferred to mean inherited, 4-7 neutral and 8-10 acquired). Thus, it is possible to see if the student had no difference between their voting and debating position (e.g., both inherited) so a disagreement of zero, differed slightly (e.g., inherited to neutral or neutral to acquired) so a disagreement of one, or were completely different (e.g., inherited to acquired) so a disagreement of two. This measure was called a congruity score. A second coder blind to condition coded 25% of the debates and reliability by Cohen's kappa (Cohen, 1960) was acceptable (κ = .85, p < .001).

Table 4
Median (and IQR) congruity scores between positions in the votes and debates in Study 2

	Vote condition		
	Public (n = 29)	Anonymous (n = 27)	Private (n = 17)
Vote 1 difference to debate	.80 (.55-1.05)	.84 (.51-1.15)	1.0 (.69-1.31)
Vote 2 difference to debate	.75 (.42-1.8)	.75 (.47-.98)	1.0 (.71-1.29)

Kruskal-Wallis test showed a significant main effect of condition on this congruity score for Vote 1, $H(2) = 10.80$, $p = .005$, and a trend for Vote 2, $H(2) = 5.59$, $p = .053$. Students in the private condition showed greater incongruity between their stance in the debate and their vote than both the public condition (for Vote 1, $U = 124$, $p = .005$, $r = .41$, and for Vote 2, $U = 139.5$, $p = .026$, $r = .33$) and the anonymous condition (for Vote 1, $U = 112$, $p = .002$, $r = .45$, and for Vote 2, $U = 141.5$, $p = .032$, $r = .32$). There were no differences between the public and anonymous conditions, $U = 383$ and $U = 403$, ns. Thus, it would seem that students voting privately are more likely to express views in the debate that do not match their vote.[3]

3.4. Discussion

Study 2 replicated many of the findings of Study 1. Analysis of the vote shifts (Hypothesis 2a) revealed that students expressing their views anonymously showed the greatest change in position from their first to second vote (an average of 1.65 per topic). This change was significantly greater than in the private condition (1.00 per topic) and manifested as a trend for the public condition (1.125 per topic). Students in the anonymous condition also showed significantly greater deviation from the initial norm (Hypothesis 2b). These results support the predictions and replicate the principal findings of Study 1. When students can express their opinions in ways that hide their identity from their peers (although not the teacher) they seemed to take the strategic opportunity afforded by source anonymity to express their views more authentically. Furthermore, Hypothesis 2c that examined a potential negative aspect of anonymity, namely that of encouraging participants to take positions in the debate which are not accurate reflections of their beliefs, can also be rejected. Students in the public and anonymous conditions showed similar high congruity between their arguments expressed in the debate and their votes.

4. Study 3: Anonymised debating

The first two studies found no disadvantages and a number of advantages for students' voting on controversial topics in an open but anonymous manner. However, all the argumentation phases were conducted in public. In this final study, the focus shifts therefore from voting to debating, as the anonymity within debate itself is now manipulated. Only two conditions were implemented in Study 3, namely a public and an anonymous vote/debate condition as a private debate is not a sensible condition.

4.1. Hypotheses

[3] We also confirmed this finding by exploring the Spearman correlation between the votes and debate (per topic). For the private condition, there were only two significant correlations between students' votes and debate compared with 11 in the public condition and 11 in the anonymous. Consequently, this decreases the possibility that these results can be explained by students in the private condition (not exposed to other views) using a different absolute scale to students in the other conditions.

It was predicted that anonymity would affect the voting as before (Hypotheses 3a and 3b; see also Hypotheses 1a and 2a above). In reference to the debate, we expected to see increased participation in accordance with both the educational case studies and the Postmes and Lea (2000) meta-analysis. On the negative side, the lack of accountability afforded by anonymity may also increase the amount of unwanted behaviours such as flaming, overt criticism or 'messing about' (Krejns et al., 2003; Postmes & Lea, 2000). However, it could be that the teachers' knowledge of the real identities of the students may act to deter these behaviours. Therefore, no strong prediction was formed as to whether anonymity would decrease the amount of productive argumentation in favour of off-task behaviours, as given the teachers' knowledge of identities the previous findings may not apply.

To measure debating behaviour, we firstly counted the number of posts and words contributed and then coded each contribution. The best ways to code student interaction is currently receiving a lot of attention in Computer Supported Collaborative Learning (CSCL) (see Strijbos & Fischer, 2007). In our case, we decided to use a simple coding scheme to analyse the nature of the students' contributions. It aimed to code proportion of the debate that was conceptually and argumentatively productive dialogue, distinct from that concerned with task or interaction management or simply off-task behaviour. As such, it is similar to simplified versions of the coding in De Vries, Lund, and Baker (2002) or the Rainbow coding scheme of Baker, Andriessen, Lund, van Amelsvoort, and Quignard (2007).

4.2. Method

4.2.1. Design

Study 3 employed a 2 by 2 mixed design. The first factor, voting and debating condition, was between groups and had two levels, namely anonymous and public. The second factor, time, was within groups and had two levels, namely Vote 1 and Vote 2.

4.2.2. Participants

All 84 participants were A-level General Studies' students and were aged between 16-17 years. In total, four classes participated in this study and were taught by different teachers, one male teacher and three female teachers. Of the four classes, Class 1 ($\underline{n}$ = 26) and Class 2 ($\underline{n}$ = 15) were randomly assigned the public voting and debating condition (total $\underline{n}$ = 41), Class 3 ($\underline{n}$ = 24) and Class 4 ($\underline{n}$ = 19) were given the anonymous voting and debating condition (total $\underline{n}$ = 43). Unfortunately, due to issues of consent, gender information was not available for Study 3.

4.2.3. Procedure

Study 3 took place in a different school to the first two studies, with different structures (one teacher per class rather than one for all classes) and different topics taught. The theme of "Digital Culture & Technology" was selected by the lead teacher; all students attended a lecture on this topic by a guest speaker. The (one hour) debate which followed was designed for students to critically discuss themes arising from the lecture. Thus, there were five main phases to the lesson. Phase 1 consisted of the guest lecture, and took place in a large room with all students attending. After the lecture, the

students returned to their usual teaching classrooms for the CoFFEE sessions. The following phases were then conducted identically to Study 2 with the exception that the topic and hence questions were changed to (a) "Do you think that new technologies make the world a better place?", (b) "Do CCTV[4] cameras make the world a safer place?", (c) "Do new communication technologies (i.e., e-mails, web forums, podcasts etc.) help with learning?", and (d) "Should you be allowed to bring mobile phones into schools?" The students were required to vote on a 5-point scale from 5 (I agree with these issues) to 1 (I disagree with these issues).

4.3. Results

4.3.1. Vote results

From the total of 84 students, 17 (13 public and 4 anonymous) have been excluded from the vote analyses due to failure to vote on least one of the topics at Time 1 or Time 2 (5 students missed only one topic, 4 missed two, 3 missed three and 5 missed all four). There was no impact of condition on students' vote shift (for the public condition: Mdn = 1, IQR = 0-2; for the anonymous condition: Mdn = 2, IQR = 0-5), U = 467.00, ns. This is perhaps unsurprising, as there were no differences between these votes across the sessions (Z = .56). Second, the impact of vote-debate condition on whether the students' votes deviated from the initial norm was examined. Unexpectedly, Vote 1 deviation differed between the conditions, U = 976, p < .01, r = .52, as the public condition (Mdn = 3, IQR = 1-5) deviated more from the initial norm than the anonymous condition (Mdn = 2, IQR = 0-4). However, as students in both conditions were unaware of each other's positions (and hence the initial norm) during this vote, this presumably represents prior differences in opinions. There was no significant effect of vote-debate condition for how the students' Vote 2 deviated from the initial norm (for the public condition: Mdn = 4, IQR = 3; for the anonymous condition: Mdn = 3, IQR = 2), U = 448.50, ns.

4.3.2. Debate results

Table 5 shows the contributions and total word count for the debate topics (two students from the total of 84 were excluded for failing to contribute to the debate). Friedman's tests revealed a main effect of topic for the number of contributions, $\chi^2(3, N = 82) = 20.37$, $p < .001$, and the number of words, $\chi^2(3, N = 82) = 13.26$, $p < .01$. The first topic had the greatest amount of discussion. Students in the anonymous condition made more posts than in the public condition, U = 300.0, p < .005, r = .34. There was no difference in word count between the anonymous and public conditions, U = 493.0, ns (Table 5).

[4] Closed circuit television.

Table 5
Median (and IQR) number of contributions and words for the four topics by vote condition in Study 3

		Vote condition			
		Public (n = 39)		Anonymous (n = 43)	
	Topic	Posts	Words	Posts	Words
1	New technologies	2 (1-3)	18 (0-36)	3 (0-6)	15 (0-31)
2	CCTV cameras	2 (1-3)	17 (0-40)	3 (1-5)	17 (0-42)
3	ICT and learning	1 (0-2)	10 (0-25)	2 (0-5)	16 (0-34)
4	Mobile phones	2 (0-2)	13(0-41)	2 (0-4)	13 (0-30)
	Total	7 (2-12)	62 (0-124)	11 (2-20)	60 (0-128)

However, this does not reveal what types of contributions students were making. Anonymous students were contributing more but it is important to ascertain if those contributions were on topic. Consequently, the content of the debates were coded for in terms of whether the contribution was debate, social, management or off-task (presented in Table 6). The unit of analysis was the post/contribution as given their short length (M = 7.7 words, SD = 4.18), further segmentation was not required. A second coder (blind to condition) coded 25% of the debate (Cohen's $\kappa = .86$, $p < .001$).

Table 6
Coding scheme with examples in Study 3

Code	Definitions	Examples
Debate	Any contribution focused on the debating and discussing the set topic including opinions, argumentation.	"It weird not knowing who is watching you (on CCTV)." "Phones shouldn't be allowed in schools as they distract students."
Social	Contributions concerned with maintaining social relations between the students such as politeness, greetings whilst debating the set task.	"Pull yourself together." "Lol (laugh out loud)."
Management	Any contribution concerned with managing the progression of the task including task and interaction management.	"I meant to put it as disagree." "I was using it as an example."
Off Task	Any contribution unrelated to the set topic or managing the debate.	"Anyone watching heros 2 nite?" "What's your number?"

For each student, the total number of contributions and words posted in each of the above categories was tallied across the four debates. However, there were insufficient data to analyse the on-task categories of Social and Management. Therefore, these four codes were combined into two: (a) on-task (debate, social support of debates, management), or (b) off-task interactions, and analyzed nominally (Table 7).

Table 7
Number of students who were off-task by debate condition in Study 3

	Vote-debate condition	
Categorical code	Public (n = 39)	Anonymous (n = 43)
Always on task	23	12
Not always on task	16	31

This suggests that students debating anonymously were contributing more to the discussion but only in a manner that is off-task to the set debates, $\chi^2(1, N = 82) = 8.07$, p

< .01. This is of obvious concern to the smooth running of a networked debate. Consequently, the final analysis explored if this was a persistent behaviour or if off-task interaction was a relatively short-lived phenomenon. Therefore, on- and off-task behaviour was analyzed for both the first and final topic (Table 8).

Table 8
Number of students who were off-task by debate condition in the first and final topic in Study 3

	Vote-debate condition			
	Public (n = 39)		Anonymous (n = 43)	
Categorical code	Always on task	Not always on task	Always on task	Not always on task
Topic 1	33	6	19	24
Topic 4	27	12	35	8

During Topic 1, significantly more students made off-task remarks in the anonymous condition, $\chi^2(1, N = 82) = 14.4$, $p < .001$), but in Topic 4 there was no difference between the conditions, $\chi^2(1, N = 82) = 1.6$, ns. Furthermore, students in the anonymous condition significantly reduced their amount of off-task interaction over the topics (McNemar, $p < .001$) whereas there was no change for the public condition (McNemar, $p = .11$).

4.4. Discussion

Study 3 explored the impact on students' classroom debates when both the vote and the debate were anonymous. This time, in contrast to the support found for Hypotheses 1a and 1b and 2a and 2b in both previous studies, no profound impact of condition on students' voting behaviour was found (Hypotheses 3a and 3b). Possibly, the lack of significant difference between public and anonymous final deviation given their significant initial deviation shows the same processes at work in this study as the earlier ones. Anonymity did change how students debated with one another. Students in the anonymous condition showed increased participation in the discussion (in terms of the number of posts contributed) with each student contributing an average of 10 posts in the anonymous condition compared to seven in the public condition. However, analysis of the debate content suggests that the increased number of posts in the anonymous condition was due to students engaging in off-task discussion. Overall, 72% of students in the anonymous debates made at least one off-task contribution compared to only 41% of students in the public debate. Some of this was provocative critical discussion of their fellow students ("flaming") but much was just joking around and discussion of their social engagements and interests. It can be seen that the less beneficial aspect of reduced accountability provided by anonymity did in fact impact upon the debate, even though participants should have been aware they were not anonymous to their teachers. Happily, analysis of the students' behaviour over the debate shows a desirable reduction in off-task behaviour. In the first topic debated, 15% of students in the public debate and 56% in the anonymous debate contributed at least one off-task post. During the final debate, 31% of students in the public debate and 19% in the anonymous debate went off-task, which is a significant reduction in the case of students in the anonymous debate.

5. General discussion

Three studies were conducted that explored the impact of anonymity on classroom votes and debates. Studies 1 and 2 focused on exploring the impact of anonymity on the vote phases of the lesson. These studies found that students voting anonymously were more likely to show a change in their vote after the debate and were also less likely to conform to group norms than those voting publically. The comparison with students voting privately suggests it is not the exposure to information about others' views that causes conformity but the requirement to reveal one's own view. This is consistent with the explanation provided by the SIDE theory. Depersonalisation was not expected to be seen in these studies as participants were collocated and well known to each other; rather students were expected to take strategic opportunity afforded by anonymity, which reduces their accountability to groups, to express opinions without fear of social evaluation.

However, Study 3 found less impact of anonymity on voting as the results did not reach significance although the direction of the results was in keeping with the other studies. This may partly be due simply to numerical opportunity; only four topics were voted upon and on a 5-point (rather than 10-point) scale. A second explanation is that Study 3 used different topics to the earlier ones. The topics debated in this study addressed the impacts of new technology. Students, irrespective of condition, did not change their views about these topics. Although, intuitively, it might be expected that the effects of anonymity will interact with the controversy of the topic discussed, in fact research evidence is mixed (see Kahai et al., 1998). Research into anonymity in group decision-making suggests that rather than controversy per se, the important dimension is how different participants' initial positions are and how anonymity is implemented (Kahai, 2009). Future work could explore how the content of the vote and debate and anonymity interact.

Study 2 also explored the relationship between votes and debates. Students in the public and anonymous conditions showed greater consistency between their positions as expressed in the vote and their positions as expressed in the debate. Students voting privately were significantly less consistent. It is difficult to determine the reason for this. It could be a deliberate attempt on the part of these students to mislead their fellows by arguing for positions that they did not hold. Or it could be that students voting privately feel less commitment to their position and so are more easily swayed to change their views in the debate. The implication for anonymising classroom debates is more straightforward. Anonymity did not lead to any increased inconsistency: students behaved similarly to those in the public condition. In this case, a feared consequence of the reduced accountability did not occur.

Study 3 focused on anonymised debating and found some negative consequences of anonymity. Students in the anonymous condition engaged in significantly more off-task behaviour, which is in keeping with other studies where reduced accountability has led to "flaming", insulting others, or generally just not engaging (Chester & Gwynne, 1998). We had hoped that as teachers in this study knew students' real identities, this would reduce the negative behaviour. Postmes and Lea (2000) suggest in their meta-analysis that increased number of critical remarks associated with anonymous CMC may

be due to participants criticising the system. However, the results of Study 3 suggest that care should be taken with this generalisation. There were no critical remarks concerning the system but where remarks were critical, they were critical of other participants. Whilst some off-task discussion is neither unexpected nor necessarily undesirable as a way of encouraging engagement with new technology in the classroom, the level of off-task behaviour observed in the anonymous condition at the beginning of the debate (45% of all posts were off-task) would clearly hinder an educational debate if it were a long-lasting phenomenon. Happily this was not the case as by the final debate only 22% of posts were off-topic.

5.1. Implications and further work

Analysis of the different conditions of voting over all three studies reveals no negative effects of voting anonymously rather than in public and many positive ones. Thus, the quantitative measures collected during the experiments accord with the focus group interviews conducted prior to the studies and with the other findings in the educational literature (Chester & Gwynne, 1998; Draper & Brown, 2004). Compared to voting privately, which shares the same lack of accountability, revealing votes is typically seen as a stimulus for debate as knowing others' positions helps clarify and direct focused discussion (Nunamaker et al., 1996). Furthermore, in Study 2 private voting combined with public debate did lead to increased inconsistency. Voting can therefore be particularly useful to teachers facilitating debates as they can swiftly direct students to issues where they see the greatest potential benefit (e.g., topics that have provoked the greatest divergence or those where students all agree but the teacher would like to stimulate alternative perspectives). In contrast, anonymising debate did not come without some negative consequences. It could be that for educational situations, anonymised voting and public debate is an ideal compromise with participants free to express their positions but then accountable for their contributions to the debate. Alternatively, as off-task behaviour rapidly diminishes it may be that the increased participation associated with anonymous debate is worth initial short-lived problems.

On the whole, this study and the others reported in the educational literature have suggested more benefits of anonymity than research in CMC and social psychology in general whereas researchers recently have emphasised the depersonalising effects of anonymity (Postmes et al., 2001). The dominant approaches within the two fields typically differ in many ways (e.g., length of study, different approaches to anonymity, nature of the task, age of participants, participants already familiar, case studies versus experiments) so it is difficult to know what might account for the contrasting findings. It does suggest that care should be taken from generalising from this literature without checking its relevance to real educational contexts.

This caution suggests that further work is needed in educational contexts. A key limitation of our studies (and many others in social psychology) was the short time period it was conducted over. This had obvious limitations on the quality of the debate, particularly in Study 3. In addition, if anonymity is to be implemented in classrooms regularly it may be that these results change. On the one hand, research suggests that cues to identity or social group can leak over time (Hayne & Rice, 1997; Postmes et al., 1998). On the other hand, it may be that students become more strategically adept at using

anonymity with more experience. It is also the case that in these studies, teachers themselves did not use the system to interact with the students. In further work, it would be valuable to explore how much teachers and students use appropriate anonymous technologies over time in the classroom. In a longitudinal design, it would also be possible to explore the same students' responses to changes in anonymity. We employed a quasi-experimental design so that whole classes were assigned to condition. This has significantly increased the ecological validity of the studies as all participants are known to one another and formed a key element in our reasoning. It is possible that pre-existing class differences influenced the results, but this seems unlikely as (a) results replicated across different cohorts of students, (b) where multiple classes were assigned to conditions (Studies 2 and 3) there were no differences between classes—only between conditions. Finally, it should be noted that we implemented source (not participant/visual) anonymity with familiar cohorts of 16-17 year old students. Therefore, whilst these results might be expected to generalize to other similar classroom settings, it would be less likely that they would generalize to distance education where participants are more likely to be both visually anonymous and unfamiliar. On balance, however, significant benefits for students and their teachers from holding educational debates anonymously were found, and this is an additional reason to use networked environments in the classroom.

Appendix A. The formulas for the computation of the variables of the study

The dependent variables were calculated as follows:

Let:

V1 = position of student in Vote 1 per topic (1-10)
V2 = position of student in Vote 2 per topic (1-10)
Initial Norm = class median at Vote 1 per topic (1-10)
T = number of topics
N = number of students per condition

So:

Vote shift = $\left|\sum_{i=1}^{T}(V1 - V2)\right|$

First vote deviation (from initial norm) = $\left|\sum_{i=1}^{T}(V1 - Initial\ Norm)\right|$

Second vote deviation (from initial norm) = $\left|\sum_{i=1}^{T}(V2 - Initial\ Norm)\right|$

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