ERGONOMICS, 2000, VOL. 43, NO. 8, 1252–1274

Social processes and group decision making: anonymity in group decision support systems

TOM POSTMES†* and MARTIN LEA‡

†Amsterdam School of Communications Research (ASCoR), University of Amsterdam, Oude Hoogstraat 24, 1012 CE, Amsterdam, The Netherlands

‡Department of Psychology, University of Manchester, Manchester M13 9PL, UK

Keywords: Decision-support systems; Communication technology; GDSS; Teams; Group decision-making; Anonymity; Meta-analysis; Performance; Productivity.

Various social processes in decision-making groups are considered detrimental to the quality of decisions. It is often assumed that removing the ability for groups to exert strong social influence on its members improves group decisions. Group Decision Support Systems (GDSSs) are increasingly used to remedy the social faults of the decision-making process in groups. In these systems, anonymity is seen as a tool to reduce the impact of the group over its members, and therefore as the key to improved group performance. This meta-analytic review examines the assumption that anonymity in GDSSs is beneficial for group decision-making on a range of performance indicators. In 6 meta-analyses of 12 independent investigations there is no support for this hypothesis. The only reliable effect of anonymity was to lead to more contributions, especially more critical ones. An alternative model is presented to account for the findings. This model argues that performance in decision-making groups depends on the social context and relevant social norms as well as on system characteristics such as anonymity. It is concluded that the integration of anonymity into phases of group decision support does not guarantee improved performance.

1. Introduction

Group decision-making is often characterized as inferior to individual decision-making, and this inferiority tends to be attributed to social processes that occur naturally in groups (Brown 1988). In this paper an evaluation is made of the success of systems designed to remedy the dysfunctional properties of decision-making groups. These systems are called group decision support systems or GDSSs. GDSSs are increasingly popular means of aiding decision-making in a variety of organizational settings, by combining the computer, communication, and decision technologies to improve the decision-making process (Briggs *et al*. 1998, Fulk and Collins-Jarvis in press). Such technologies generally make use of anonymity of members of a decision-making group as a key tool to improve the quality of decisions (Hiltz and Turoff 1978, Nunamaker *et al*. 1991, Pinsonneault and Heppel

*Author for correspondence. e-mail: postmes@pscw.uva.nl

Ergonomics ISSN 0014-0139 print/ISSN 1366-5847 online
http://www.tandf.co.uk/journals

1998). This paper investigates this proposition in a meta-analytic synthesis of the studies that examine impacts of anonymity on GDSS use. In the process, a theoretical framework is presented to interpret the results and their implications for GDSS design and usage. The paper begins, however, by presenting a concise overview of group decision-making, GDSS design, and some of the relevant theoretical issues, before turning to examine the empirical evidence for anonymity effects in GDSSs.

1.1. *Group decision-making*

Decision-making in a variety of organizational settings is typically the province of boards, teams, units or other groups, especially where important issues are at stake. However, one may question whether this convention is sensible: various problems mar the decision-making process in groups. The literature on group decision-making has identified a variety of situations in which group decisions are inferior to individual decisions and has reported many ways in which group decision-making is suboptimal (Stroebe and Diehl 1994, Forsyth 1999). The so-called 'dysfunctions of the group' (Valacich *et al.* 1991) may be divided into process dysfunctions and social dysfunctions. *Process dysfunctions* are caused by structural characteristics of the group setting that could hinder a group from reaching its full potential. Well-documented process dysfunctions are production blocking due to unequal participation or unequal air time, characteristic of a discussion medium where only one person can hold the floor (Stroebe and Diehl 1994). Computerized exchanges are considered to hold a natural advantage here, because people may enter their comments and thoughts simultaneously. Simultaneous expression of ideas may therefore be beneficial to idea quantity (despite the potential disruptions to turn-taking, and despite the fact that typing is slower than speaking) owing to the computer's capacity for 'concurrency' (Valacich *et al.* 1993). It should be noted that these process dysfunctions impact on the difference between face-to-face and computer-supported decisions, because they are media effects. However, they are not likely to be affected by anonymity within GDSS; for example unequal air time is a problem neither in anonymous nor in identified GDSS.

Where process dysfunctions are caused by limitations inherent in the structure and form of meetings, *social dysfunctions* may hinder group productivity through undesirable social processes that occur in the group. For example, a group may constrain the quality and quantity of input from its members by social processes such as evaluation apprehension, conformity pressures, free riding, social loafing, cognitive inertia, socializing, domination due to status imbalance, groupthink and incomplete analysis (Steiner 1972, Stroebe and Diehl 1994). These problems stem from processes inherent in all groups (Brown 1988, Haslam 2000). More precisely, all these dysfunctions are rooted in the ways in which group members adapt their behaviour to the group. Based on either perceptions of the group or its members (including the self) people adapt to the group by contributing either different content, less, or more. The assumption tends to be that none of these adaptations is productive: on average group contributions tend to be inferior (for example less rational and original) to individual contributions. It is for this reason that groups can rarely capitalize on the potential to enrich individual decisions through synergy. Although the generality of these assumptions has been questioned (e.g. Haslam 2000), the prevalent analysis of group decision-making is that social influences within the group lead the rational individual astray.

The analysis of the causes of social dysfunctions of the group contains a suggestion for its remedy. If social influences lie at the heart of flaws in decision making groups, then group decisions may be improved by disabling these social influences. Various theorists have focused on *anonymity* as a powerful way of reducing social influence, and have turned to GDSSs to provide a decision environment that maintains a group's synergy but removes its dysfunctions (Hiltz and Turoff 1978, Huber 1984, Nunamaker *et al.* 1987, Jessup *et al.* 1990b).

1.2. *GDSS design*

In the past decades, various techniques have been proposed to improve group decision-making. For example, in the 1970s the Nominal Group Technique (Delbecq *et al.* 1975) and the Delphi method (Linstone and Turoff 1975) were developed as structured alternative meeting procedures to improve on normal face-to-face group meetings. Both techniques structured group decision-making by prescribing several 'rounds' of decision-making and by detailing the objectives and methods for each round. These procedures (for reasons that will be explored in depth in the next section) relied heavily on anonymity as 'one of the strongest techniques to prevent conformity to group pressures' (Hiltz and Turoff 1978: 283). With the advent of computers, the procedures embedded in these techniques could be handled more efficiently by computer networks, especially where these procedures involved managing rounds of interaction and the writing and exchanging of notes (Hiltz and Turoff 1978).

Thus, at the beginning of the 1980s various systems were designed and developed that aimed to provide decision-making groups with support, and anonymity was usually one of its central features (Turoff and Hiltz 1982, Huber 1984, Applegate *et al.* 1986, DeSanctis and Gallupe 1987, Dennis *et al.* 1988). Typically, these systems offer decision-making groups the opportunity to use computer support for one or more stages of decision-making. The support may range from displaying common information on computer screens to using communication via a GDSS in all stages of the decision-making process. Support may be aimed at (1) the generation of proposals (opinions, ideas or solutions) and subsequent commenting, (2) the presentation, clarification, summarization and synthesis of proposals, and (3) a choice among alternative proposals (DeSanctis and Gallupe 1987).

Although systems may differ from each other on many dimensions, there are many similarities in the procedures that they use. One of the most commonly used systems at present appears to be Groupsystems™ (Groupsystems.com, Tucson, AZ) (Valacich *et al.* 1991) which fits the description of GDSSs given here, and which was used for most of the studies in the analysis. Of course, GDSSs are constantly evolving, and some systems may differ from the description that follows, in particular where GDSSs increasingly make use of speech and video. GDSSs are typically used in settings where decision-makers are seated in a large room, each behind their own computer terminal. The users face one or more screens on which common information may be displayed. Through keyboard input they offer their judgements and comments to the group, and this is most often done anonymously. The method by which information is shared among users may vary somewhat from system to system and from setting to setting. Sometimes, users see others' input immediately, sometimes they see only part of it (as selected by the software or the facilitator of the meeting), and sometimes they do not see any of it at all. These systems tend to be

used in large organizations, and increasingly they are used to support decision-making for users who are dispersed among different locations. As a rule, the information exchange is text-based or involves the display of figures and/or charts.

In sum, GDSSs are text-based tools designed to remedy particular problems of decision-making in co-present groups. These systems claim to remove the social obstacles that prevent individuals from attaining their full potential in the group. Anonymity is central to achieving this, according to various theories of GDSS effects. Next, these theories and the arguments for the proposition that anonymity has an impact on group processes are examined.

1.3. *Theory: anonymity and group performance*

What distinguishes GDSSs from other group decision environments is that GDSSs rely on mediation of communication by a computer network, and many of the presumed effects of GDSSs are based on theories about the social effects of mediation. Most of these theories focus on the restriction of bandwidth that mediation necessarily involves (Lea and Giordano 1997). For example, it is often claimed that mediated communication removes the personal and social cues on which we depend for much of our social rapport in everyday interaction (Short *et al.* 1976, Kiesler *et al.* 1984). In most communication media (such as text-based interaction via computers) non-verbal behaviour and paralinguistic cues are absent. Restricted bandwidth thus removes information that we normally have in face-to-face interaction. For this reason all types of text-based Computer-Mediated Communication (CMC) *including GDSSs*, are often characterized as being relatively anonymous (Postmes *et al.* 1998a). Increasingly, these systems are being augmented by video communication for which this is arguably less of a problem. Some have claimed that this anonymity makes communicators *deindividuated*. That is, communicators no longer individuate each other because of a lack of personal and social cues (Kiesler *et al.* 1984, Hiltz *et al.* 1989, Jessup *et al.* 1990b, Valacich *et al.* 1992b, Pinsonneault and Heppel 1998).

Deindividuation is a psychological process that is classically associated with extreme *anti-normative* behaviours that are often negative and violent, and sometimes benevolent; for a review refer to Postmes and Spears (1998). According to deindividuation theory, deindividuation is a state of decreased self-awareness that fosters a disregard for social norms and conventions. Deindividuated behaviour is therefore anti-normative and disinhibited (Zimbardo 1969, Diener 1977, Prentice-Dunn and Rogers 1989). In their review Postmes and Spears (1998) show the empirical support for this to be very limited. In CMC, deindividuation has been identified as the cause of 'flaming', extreme decision-making, greater equality of participation and disregard for status hierarchies. Thus, social psychology and research on CMC have concluded that anonymity in group interaction has anti-normative if not anti-social consequences. One major consequence of anonymity, therefore, is that it diminishes the social influence of the group over the individual.

GDSS theorists have focused on the beneficial effects that accrue from anonymity and deindividuation. The reason is that anonymity and deindividuation, in addition to their negative effects, diminish the social influences of the group over the individual that are dysfunctional for decision-making (Hiltz and Turoff 1978, Huber 1984, Applegate *et al.* 1986, Jessup *et al.* 1990b, Nunamaker *et al.* 1991, Valacich *et al.* 1992b, Dennis and Gallupe 1993, Miranda 1994). In group decision support the anti-normative effect of deindividuation may be used as a potential tool to neutralize

the dysfunctions in the group, such as pressures to conform and social loafing. Also, anonymity may counter excessive pressures on group members to arrive at consensus, and thereby neglect crucial decision alternatives (Janis 1982). Thus, anonymity is used to liberate the individual from undesirable group influences, and thereby to combat the group dysfuntions discussed above. In this sense, anonymity provides group members with the opportunity to express themselves:

> A manager could for example, treat anonymity as an on-and-off switch, switching it on for problems *requiring the identity of individuals*... and switching it off for problems for which anonymity is better (Jessup *et al.* 1990b: 344, emphasis added).

It should be noted that this proposal appears to be the exact opposite from classical deindividuation theory's proposal that individuation leads to more rational and restrained behaviour. The reason for the discrepancy is that deindividuation theory focuses on the positive (regulatory) properties of normative influence, whereas GDSS theory focuses on its negative (restrictive) properties.

Although the literature has claimed that anonymity may remedy the social dysfunctions of the group by reducing social influence, this has not always been accompanied by a thorough analysis of what anonymity is. One can distinguish two aspects of anonymity that may impact on the degree of social influence in the group (Reicher *et al.* 1995, Postmes and Spears 1998). The emphasis here is not so much on the particular forms that anonymity may take (for more detailed analyses see Valacich *et al.* 1992b, Hayne and Rice 1997, Anonymous 1998), as on their psychological effects (see also Pinsonneault and Heppel 1998). In this regard a distinction can be made between two processes that anonymity in groups may impact on. On the one hand anonymity impacts on the *accountability* towards an audience, which could potentially reduce the influence of the group over the individual. The cover of anonymity may reduce social controlling and sanctioning power, and hence have a liberating impact on group members during the decision-making process (Postmes *et al.* 1998a). Indeed, it has been argued that anonymity effects in GDSS are primarily a function of this type of anonymity, which is associated with participants' awareness of themselves as social objects in relation to an audience (Pinsonneault and Heppel 1998). On the other hand, anonymity may also impact on *depersonalization* of perceptions of others in the group (Postmes *et al.* 1998a), and could thereby reduce the attachment of the individual to the group (Valacich *et al.* 1992b). Thus, anonymity may reduce the interpersonal immediacy and presence of the other group members, and thereby minimize the group's impact on thoughts and behaviours of the individual within it. In other words, anonymity could impact on people's awareness of the public as consisting of individuals—a feature associated in the deindividuation literature with reductions in private self-awareness (Matheson and Zanna 1988, Prentice-Dunn and Rogers 1989).

Both these mechanisms may contribute to reduce the social dysfunctions that may be found in the group. At least some of the group dysfunctions can thus be remedied, for example conformity pressures should be reduced because the group lacks controlling and sanctioning power (Nunamaker *et al.* 1997), and the mediating process here could be the reduction of the awareness of the audience. Conversely, evaluation apprehension could diminish as a result of the reduced sense of presence of others (Valacich *et al.* 1991, 1992b, Nunamaker *et al.* 1993), and depersonalization may underlie this effect of anonymity.

In sum, the main distinction between accounts of anonymity in the GDSS literature and those in the social psychological literature is the emphasis in the former on the positive consequences of anonymity and in the latter on the negative consequences of anonymity. Despite this difference in conclusion, they both share the basic assumption that *anonymity achieves its effects on group behaviour by reducing the impact of the group over the individual*, and hence the social influence in the group. Owing to this underlying process, anonymity in GDSSs has been argued to reduce dysfunctional social processes that hinder the group from reaching its full potential. As a result, several theorists have predicted that anonymous GDSSs should increase the number of valuable ideas and useful solutions, and therefore improve the quality of decision-making in general. Thus, it is assumed that anonymity is an important reason for GDSS-supported groups to perform better than face-to-face groups.

1.4. *Empirical findings: performance in GDSSs*

Given the current popularity of GDSSs, it is not surprising that a substantial body of experimental research has investigated the impact of GDSSs on group performance. On the whole, research has confirmed that GDSSs have positive effects on some aspects of group decisions. For example, McLeod (1992) conducted a meta-analysis of 13 studies comparing group process and performance in GDSSs with unsupported interactions. Her findings show that the impact of GDSS use tends to be positive on some variables, such as decision quality and task focus, but negative on others, such as the time to reach a decision, the consensus within the group, and user satisfaction. Partly due to the uniformity of effects, the analyses produced little indication of what features of group support systems were responsible for the effects. In particular it remains to be tested whether anonymity associated with group support systems caused the observed effects on key variables. More recent meta-analyses with larger samples support McLeod's conclusions, but show that certain exceptions to GDSS effects (positive and negative) may exist (Benbasat and Lim 1993, Chun and Park 1998). For example, the impact of GDSS support is moderated by factors such as task complexity (simple tasks having greater benefit from GDSS support), group size and member proximity, and the level of GDSS support.

Inconsistent with these findings are results reported in a meta-analysis examining the impact of computer-mediation with CMC systems on task focus (Walther *et al.* 1994). For the 12 studies included in this research synthesis it was found that computer-mediation *per se* did *not* lead to more task-orientation, a finding that is at odds with McLeod's. As a certain degree of anonymity is a feature of both CMC and GDSSs, however, it appears that anonymity can not account for this discrepancy. Rather, it seems plausible that GDSSs tend to foster task-orientation owing to the system's design, which consistently emphasizes the need for rational individual input in its procedures. In contrast, in the studies included in the analysis by Walther *et al.* (1994), there were no such procedures: CMC systems do not offer cues to rationality, and allow relatively unstructured discussions. Thus, the positive effects of GDSSs on task focus may be related to the nature of the system's procedures, rather than to anonymity. The degree to which computer-mediation accentuates task-orientation may covary with the extent to which these systems themselves promote rationality and task-orientation.

In sum, GDSSs overall have a positive impact on decision quality, but a negative impact on time to reach a decision and consensus. One striking aspect of this literature, however, is that it has not been able to resolve *why* GDSSs have these effects. In particular, the literature fails to test the assumption underlying GDSS design that anonymity would be responsible for improved group performance. One reason for this failure is that experimental research has often compared groups with GDSS support to non-supported groups. A problem in such comparisons is that they confound anonymity and other potentially influential variables. For example, a group with GDSS support is not only more anonymous than a non-supported group, but it also lacks the structure imposed by GDSSs, there is concurrency, and people type rather than speak. Moreover, a majority of studies comparing GDSSs to conventional decision-making used GDSS in Decision Rooms. In such rooms, participants face each other and sometimes verbally interact in addition to the electronic interaction. Therefore it cannot be assumed that there was greater anonymity in GDSS-supported groups than in unsupported control groups.

Hence, the role of anonymity in producing GDSS effects remains a mystery, despite the sophistication of these secondary analyses. In order to examine the theoretical claims of GDSS use and GDSS design regarding anonymity's beneficial effects, one needs to focus more closely on the impacts of anonymity on group processes where anonymity is *unconfounded* with other variables.

1.5. *Empirical findings: anonymity and performance in GDSSs*

Although many studies have isolated anonymity as a variable of interest in determining the effects of GDSSs, there have been no systematic (quantitative) reviews to date. On the basis of overviews of the literature, some researchers have concluded that the impact of anonymity is generally positive (Dennis and Gallupe 1993, Jessup and George 1997, Nunamaker *et al.* 1997), but others have contended that evidence is limited and inconsistent (Pinsonneault and Heppel 1998). However, it should be noted that these reviews have only provided subjective interpretations of findings, or crude categorizations as 'supportive' or 'non-supportive' on the basis of significance levels. In a research domain that tends to focus on group-level effects, this is a potentially misleading strategy: group-level analyses tend to reduce the statistical power of tests, and strong and interesting effects may be dismissed as being non-significant (Cooper *et al.* 1998). Moreover, the conclusions drawn in these prior overviews are inconsistent, which may be caused by reviewers' tendency to focus on different performance indicators, such as quantity of solutions (or ideas) generated in electronic brainstorming, decision quality and idea quality. Hence, a systematic review of anonymity's impact in GDSSs is especially important given explicit theoretical and practical concerns with enhancing decision quality and the quality of group performance through GDSS use (Fulk and Collins-Jarvis in press).

One of the reasons for the apparent inconsistency of anonymity effects in the GDSS literature may be gauged from the impacts of anonymity in groups more generally. Postmes and Spears (1998) examined the impact of anonymity in groups, and especially the hypothesis of deindividuation theory that anonymity and other deindividuating factors decrease social influence and self-awareness. In a meta-analysis of 60 studies, anonymity had no such effects. In particular there was no evidence that (1) anonymity leads to anti-normative or disinhibited behaviour or that (2) anonymity impacts on self-awareness (private or public), the supposedly responsible process. In fact, Postmes and Spears (1998) found support that

anonymity and other deindividuating factors can foster *stronger* social influence. The implication of these results for group decision theory is that anonymity does not simply reduce social influence in decision-making groups (but may even increase it). Therefore, the assumption prevalent in group decision theory that anonymity leads to improved performance in group decisions does not appear to be based on solid theoretical foundations.

The primary objective of the meta-analysis reported here is to explicitly test the hypothesis that anonymity produces beneficial effects in electronic group processes and outcomes. In particular the authors will focus on four central performance indicators of group decision-making: decision quality, the quantity of solutions or ideas generated (also used as an index of task-focus), user satisfaction, and perceived effectiveness as outcomes of group decisions. Unfortunately, insufficient studies report the degree of consensus (number of studies, $k = 2$) or time or reach consensus ($k = 2$) for inclusion of these variables in the meta-analysis. On the basis of the literature on GDSSs, one would expect that the positive effects of these systems generally reported in the literature (McLeod 1992, Benbasat and Lim 1993), may be attributed to anonymity. Therefore one would expect that anonymity would be associated with improved performance. However, a consistent absence of significant effects in this analysis would indicate that features of GDSSs other than anonymity were responsible for the earlier observed effects in prior analyses, and this would cast doubt on the theoretical assumptions underlying GDSS design and the dysfunctions of group decision-making more generally. On the basis of the authors' own prior research into the effects of anonymity on social influence (Spears and Lea 1992, Postmes and Spears 1998, Postmes *et al.* 1998a) it is predicted that anonymity does not straightforwardly improve the performance of decision-making groups.

In addition, the impact of anonymity on two other indicators of group performance, the overall number of statements and the number of critical remarks is examined. The first is included mainly as a control variable: if the total number of statements is larger, this may account for more decision proposals or better decisions. The number of critical remarks is sometimes used as a index of disinhibition or 'flaming,' and is therefore associated with deindividuation (Kiesler *et al.* 1984, Valacich *et al.* 1992b). Although it should be noted that the number of critical remarks is a rather imperfect operationalization of the flaming concept (see Lea *et al.* 1992 for a review), the authors examine the hypothesis that anonymity is associated with more flaming. Previous reviews have shown that there is no more flaming in CMC (Walther *et al.* 1994) and that deindividuated and anonymous settings in general do not lead to disinhibited or anti-normative behaviour (Postmes and Spears 1998). Therefore, it is predicted that anonymity will have no effect on the number of critical remarks.

2. Method

2.1. *Meta-analytic procedures*

The approach used in this study was to examine evidence through a systematic quantitative integration of different experimental examinations of GDSS use in a meta-analysis (Rosenthal 1991, Cooper and Hedges 1994a). The choice of a meta-analytic method to integrate results was based on several considerations. Principally, a meta-analysis can be used to assess the strength of a relation between an independent and dependent variable. Each observation of such a relation (i.e. each

empirical study) can be used to assess the strength of the antecedent variable (anonymity) on the consequence (one of several performance indicators). The statistics reported in each study were converted into an effect size index. The present analysis uses as its effect size the correlation coefficient r, which can range from -1 to 1 (other indices are d, or η^2 which is identical to r^2). Cohen (1977) argues that an effect size of $r = 0.1$ is a small effect, $r = 0.3$ is a medium size effect and $r = 0.5$ is a large effect. The effect sizes of various studies can be combined to assess the magnitude of effects in the literature, which is a special advantage in literatures such as that on GDSSs, because the unit of analysis is groups. This significantly reduces the power of individual tests, while increasing the chance of type II errors for individual studies. Combining studies is therefore a big advantage. A final consideration is the number of independent empirical tests examining the impact of anonymity in GDSSs, and the variety of performance indicators used. A traditional review would have difficulty in summarizing the results of so many studies.

Recommendations by Rosenthal (1991) and Cooper and Hedges (1994a) were followed for a fixed-effects model analysis (the choice of a fixed effects approach was based on the limited variety of operationalizations and dependent measures used in the present sample: Cooper and Hedges 1994b). Weighted averages of effect sizes were computed using the Fisher transformation of r, Z_r, using sample sizes as weights. Each study was treated as an independent data point.

2.2. *Literature search and coding*

The analysis focused on experimental studies involving anonymity manipulations in GDSSs. A literature search was conducted to find all (quasi) experimental investigations of anonymity effects in GDSSs. The authors performed a computerized search of Psychological Abstracts via PsycLit on CD-ROM (with experimental social science publications from 1887), the INSPEC database (with information technology titles from 1969), and a computerized search of Dissertation Abstracts from 1960. References from the publications found were examined in order to trace further journal articles and unpublished reports. Criteria for eligibility in the meta-analysis were that (1) only quasi-experimental field studies or experimental studies were included, (2) these examined the decision-making using a GDSS or GSS, (3) in these anonymity was an independent variable. In this way, 12 independent studies were uncovered (see the appendix), investigating 1432 participants in 332 groups, and yielding a total of 43 hypothesis tests relevant to the present analysis (see the appendix for an overview of the major variables derived from these studies). These studies were coded for a number of characteristics (year of publication, population, sample size, group size, type of GDSS and tools used, decision task, type of anonymity manipulation, setting, session duration, gender composition, and effect sizes r).

Three dependent measures of group output were included in the analysis. The *number of original solutions* in electronic brainstorming sessions was measured in $k = 10$ studies (this measure has previously been associated with the degree of task-focus, Kraemer and Pinsonneault 1990, McLeod 1992). Eight studies measured *decision quality*, obviously the most important dependent measure for the quality of group performance. Seven studies reported subjective ratings of participants' overall *satisfaction*. In addition, two measures of group process were included: the total number of contributions made ($k = 9$), and the number of critical remarks ($k = 6$).

The latter has been associated with anti-normative behaviour in some of the studies reported (Sosik 1997). Finally, three studies reported participants' ratings of effectiveness of the GDSSs.

3. Results

The studies included in the meta-analysis tended to manipulate identifiability by tagging contributions to the discussion with the names of the contributor, and manipulate anonymity by leaving messages untagged (Hiltz *et al.* 1989, Connolly *et al.* 1990, George *et al.* 1990, Jessup *et al.* 1990a, Jessup and Tansik 1991, Valacich *et al.* 1992a, McLeod *et al.* 1997, Postmes and Spears 1997, Sosik *et al.* 1997). However, in some studies the identifiable participants were also introduced to each other prior to the group decision (Connolly *et al.* 1990, Valacich *et al.* 1992a). In two studies, identifiability towards the experimenters was induced by explicitly recording participants' telephone numbers and personal details (Jessup 1989, Studies 1 and 2). One study manipulated physical identifiability as well as message identifiability by varying the degree to which participants were physically proximate (Jessup and Tansik 1991). Finally, one study used a very subtle manipulation of identifiability, by tagging messages only with a terminal number (Cooper *et al.* 1998). In sum, these manipulations are quite homogeneous and comparable. The differences between anonymity manipulations were coded for, and used as possible moderators to predict variations in effect sizes, if any (Shadish and Haddock 1994).

In addition, the sample was homogeneous in terms of other characteristics of study design. Although different types of tasks were used, and to some extent different participants, all studies used more or less comparable settings of *ad hoc* groups meeting generally for no longer than 30 or 40 min. Moreover, most of the studies examined anonymity's impact on electronic brainstorming or other text-based exchanges, and coded for similar process measures. The homogeneity of studies' designs is beneficial in terms of a meta-analysis that aims to examine fixed effects of a variable within one set paradigm, but it should be noted that this limits the capacity to generalize findings about impacts of anonymity across settings (Cooper and Hedges 1994b).

The results of the meta-analyses are summarized in table 1. Independent analyses examined the effects of anonymity in GDSSs on six dependent variables. Anonymity produced only a small and non-significant effect on the number of solutions generated in electronic brainstorming sessions, $r = 0.12$, $Z = 1.58$, *ns*, that was stable across different studies, SD = 0.17, $Q_t = 10.08$, *ns*. Thus, with respect to task-focus, it appears that anonymity did not have any reliable impact across 298 groups to increase or decrease task-orientation. Moreover, this effect was homogeneous, and therefore it was not meaningful to search for sources of variation due to the way in which anonymity was induced, the task used, the type of GDSS or other contextual factors.

With regard to measures of decision outcomes and their quality, anonymity did not have a reliable effect on decision quality, $r = -0.02$, $Z = -0.18$, *ns*, and this null effect was stable across eight studies, SD = 0.15, $Q_t = 4.21$, *ns*. The results of decision quality and of the number of solutions are graphically presented in a funnel graph (figure 1), which plots the effect size against the number of participants (in this case groups). Normally, the results of studies are funnel-shaped around a central tendency: the average effect size. With regard to the impact of anonymity on group performance in GDSSs, however, no clear pattern can be discerned.

Table 1. Results of six meta-analyses of anonymity on GDSS outcomes.

	Central tendency							Homogeneity within classes	
	Effect size *r*	95% confidence interval		*K*	*N*	Fail-safe *N*	*Z*	*SD*	Q_t
N Original solutions	0.12	−0.04	0.20	10	298	−0.81	1.58	0.17	10.08
Decision quality	−0.02	−0.14	0.12	8	220	−7.90	−0.18	0.15	4.21
Overall satisfaction	−0.01	−0.26	0.13	7	223	−6.26	−0.53	0.21	7.08
Rated effectiveness	−0.28	−0.81	0.26	3	65	2.23	−2.17*	0.22	1.86
Total *N* statements	0.17	0.01	0.37	9	197	9.12	2.33**	0.23	10.78
Critical remarks	0.51	0.13	0.82	6	160	61.92	5.53***	0.33	22.01***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

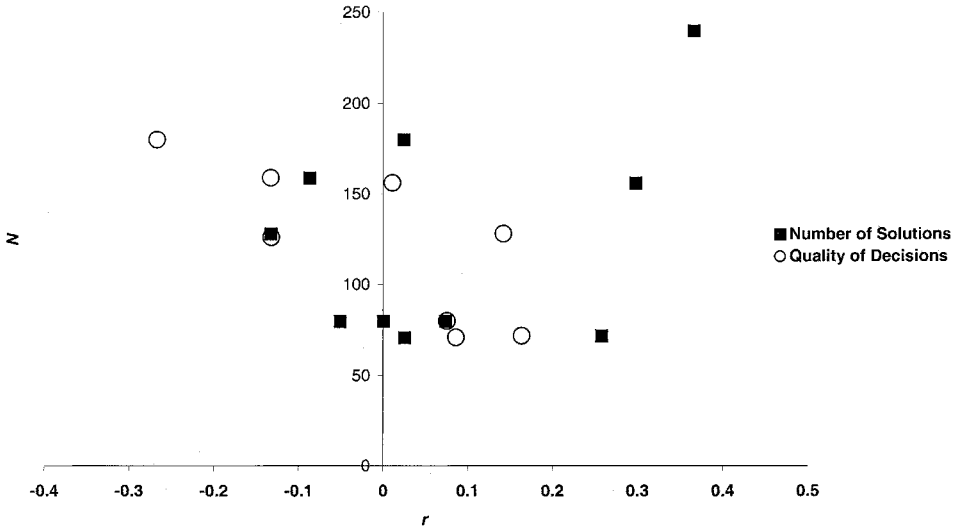

Figure 1. A funnel graph of effect sizes (r), representing the impact of anonymity on performance in GDSSs in terms of number of solutions and decision quality, plotted by sample size (N).

The strongest support for GDSS theory with regard to the number of solutions proposed was obtained in a study bordering on being an outlier in terms of effect size as well as sample size, which used a different manipulation of anonymity than other studies (Cooper *et al.* 1998). It is noteworthy that the manipulation of anonymity used in this study was subtle compared with other studies, namely to identify contributions by terminal numbers versus providing no identification at all. This finding suggests that anonymity *per se* may not have any impact on idea generation, but that what matters is whether one can discriminate between the sources of a message. However, due to the uniformity of anonymity manipulations across the other studies, the question of what aspect of anonymity impacts on the number of proposals cannot be answered.

Anonymity had no effect on subjective satisfaction with decision-making, $r = -0.01$, $Z = -0.53$, *ns*. This null effect was stable across studies, SD = 0.21, $Q_t = 7.08$, *ns*. Thus, the subjective ratings of decision outcome and process reflected the lack of reliable effects found in the objective measures. On a further subjective measure of GDSS effectiveness, however, participants rated anonymous GDSSs as significantly less effective than identified GDSSs, $r = -0.28$, $Z = -2.17$, $p < 0.05$, and this medium effect was stable across three studies, SD = 0.22, $Q_t = 1.86$, *ns*. However, this result must be interpreted with caution because of the small number of studies included.

Thus, consistent with predictions the effects of anonymity on the key indicators of group performance in GDSSs—decision quality, idea-generation in electronic brainstorming sessions (associated with task-focus), and participant satisfaction with decisions—were not reliable. Only one performance indicator showed a reliable effect of anonymity, and it suggested that anonymity has a negative impact on group performance. Participants seemed to perceive anonymous GDSSs to be significantly *less effective* than identified GDSS conditions.

Stronger effects of anonymity were found on additional variables included in the analysis. These were counts of the total number of statements, and the number of critical remarks; variables that have not been identified as key performance indicators of decision-making groups. With regard to the total number of remarks (including task-oriented solutions, critical remarks, and all other statements) a significant but small effect of anonymity was found, $r = 0.17$, $Z = 2.33$, $p < 0.01$, that was homogeneous across studies, SD = 0.23, $Q_t = 10.78$, *ns*. This result indicates that anonymity was associated with a minor increase in the total volume of exchanges across studies. In part this effect may have been due to the other effect that was observed: the number of critical remarks was reliably higher in anonymous GDSSs, $r = 0.51$, $Z = 5.53$, $p < 0.001$, and this was a strong effect. However, this effect was not consistent across six studies, SD = 0.33, $Q_t = 22.01$, $p < 0.001$.

It therefore appears that anonymity in GDSSs is associated with an increase in the number of remarks in general, and of critical remarks in particular. However, the impact of anonymity on the degree to which group members were critical was strong but not universal or consistent. One study provides a clue as to the possible origin of inconsistencies in effects. Jessup and Tansik (1991) manipulated both anonymity of contributions and physical proximity. They found that proximity moderates the anonymity effect, such that when group members were 'face-to-face' in close physical proximity in the group decision room, anonymity produced *more critical* remarks than identifiability. Conversely, anonymous participants were *less critical* than identifiable participants when they were dispersed and hence could not see each other.

As can be seen in table 2, this effect may account for some of the heterogeneity in effects. The authors coded for whether the physical proximity in the experimental setting allowed for visual identification in the identifiability condition. In some experiments identifiable participants were identifiable only through the tags identifying their messages, for example because the decision rooms used were so large that participants would not have been able to identify fellow group members, and because they were not introduced to each other. These studies ($k = 4$) showed very strong effects for anonymity to increase critical remarks, with an average weighted r of 0.68. In contrast, those studies ($k = 3$) in which visual identifiability was a real possibility because participants had been introduced to each other, showed no overall effect of anonymity to increase or decrease the number of critical remarks, $r = 0.19$. The difference between these two groups of studies was highly reliable, $Q_b = 13.62$, $p < 0.001$, whereas the within-groups variability was no longer reliable, $Q_w = 0.10$, *ns*. Thus, anonymity increases the extent to which critical

Table 2. Physical proximity of participants in the identifiable condition as moderator of anonymity's effect on the number of critical remarks.

Study	Z_r	Physical proximity
Connolly *et al.* (1990)	0.50	Yes
Jessup and Tansik (1991), co-present condition	0.34	Yes
McLeod, *et al.* (1997)	0.79	Yes
Valacich *et al.* (1992a)	0.69	Yes
Jessup *et al.* (1990a)	0.48	No
Jessup and Tansik (1991), dispersed condition	−0.65	No
Sosik (1997)	0.23	No

remarks are made *only when* participants were introduced to each other beforehand, and were able to make visual contact during interactions. In other words, participants were not so critical when they were entirely anonymous, but they were very critical when they were partially identifiable.

4. Discussion

4.1. *Performance and anonymity*

Overall, it appears that there is no support for predictions derived from the GDSS literature in these findings. The meta-analysis demonstrates that anonymity has no reliable impact on performance indicators of group decision-making in GDSSs. Anonymity does not improve decision quality, increase quantity of ideas and solutions, or increase satisfaction. The absence of effects was consistent across studies. This pattern of results deviates from previous meta-analyses on examining GDSS performance in comparison with unsupported groups, which demonstrate reliable benefits of GDSS use on participant satisfaction and decision quality (McLeod 1992, Benbasat and Lim 1993). The present analysis therefore provides an important qualification to these studies by demonstrating that the effects in these previous reviews probably were not produced by anonymity. Instead the positive effects of GDSS use may have resulted from factors such as concurrency (Valacich *et al.* 1993, Benbasat *et al.* 1995) or the structure a GDSS imposes on the decision-making process.

The present findings disconfirm the assumption common to GDSS theory and design that anonymity is the basis of the superiority of GDSSs over unsupported face-to-face interactions (Jessup *et al.* 1990b, Nunamaker *et al.* 1991, Valacich *et al.* 1991, Scott 1994, Anonymous 1998). In addition, the present findings disprove conclusions that were drawn in prior overviews of parts of the literature and which concluded that the impact of anonymity is generally positive (Dennis and Gallupe 1993, Jessup and George 1997, Nunamaker *et al.* 1997), or inconsistent (Pinsonneault and Heppel 1998). In contrast, the present results show a relatively consistent absence of effects of anonymity. Moreover, the findings illustrate that anonymity's effects on group processes in general are less solid and less straightforward than is often assumed (Postmes and Spears 1998). As such, the present findings accentuate the need for further studies that focus on psychological process variables (e.g. depersonalization and awareness of the audience), group process variables (e.g. social identification), as well as performance indicators (e.g. decision quality), in order to further our knowledge of what makes GDSSs productive.

More generally, the present findings question some assumptions in the group decision literature. Particularly, they cast doubt on the assumption that the quality of group decisions is best served if the influence of the group is reduced. In this regard the authors suggest that the literature on group decision-making has in some parts over-emphasized the importance of group dysfunctions and their adverse impact on group productivity. Many of the 'social dysfunctions' found in groups are mechanisms that, in most situations, regulate group interactions productively and which facilitate rather than limit performance. A good example is the search for consensus that is typically found in groups. Seeking consensus has been associated with the dysfunctions such as groupthink, conformity pressures, socializing, cognitive inertia, and incomplete analysis (Steiner 1972). Yet the same process is part-and-parcel of a natural tendency for groups to search for, and expect,

agreement on issues that are central to the group (Asch 1952, Turner 1991). There are clear benefits that accrue from agreement and consensus, such as satisfaction with the group's decision, willingness to invest effort on its behalf, and group identification. Moreover, consensus forms the basis of normative regulation of behaviour and thereby of standards and expectations for group members' behaviour. Thus, the same properties of groups that are branded 'dysfunctional' may sometimes (especially in groups with a longer history and future than experimental laboratory groups) be highly functional for group members subjectively as well as for more objective performance indicators. Moreover, for many group decisions consensus may be defined as the central objective (see also Haslam 2000). Thus, rather than focusing on evaluations of what is functional and dysfunctional in groups, closer empirical analyses to examine the functioning of groups is advocated.

4.2. *Adverse effects of anonymity*

Two significant effects of anonymity were observed on process variables that are less central to theories of GDSSs, namely on the total number of remarks generated during discussions, and on the number of critical remarks. The latter effect was inconsistent with the predictions. The small to moderate effect of anonymity on the number of remarks was a general finding, consistent across studies. However, the presence of these effects in the absence of any significant effects on performance suggest that although interesting in themselves, alterations in these processes produced by anonymity are not necessarily related to improved group performance. In addition, the large number of critical remarks for anonymous groups may well have contributed to the effect on the total number of remarks.

The occurrence of more critical remarks has sometimes been related to deindividuation (Valacich *et al.* 1992b, Nunamaker *et al.* 1997, Sosik *et al.* 1997). However, the present findings do not support the notion that deindividuation would be the basis of this effect. Theoretically, the equation of critical remarks with anti-normative or disinhibited behaviour is questionable—being critical can be normative or anti-normative, and civil or unrestrained (Lea *et al.* 1992). Moreover, the present findings are inconsistent with deindividuation theory's predictions. The theory classically predicts that anonymous settings foster more unrestrained and deindividuated behaviour (Postmes and Spears 1998). However, the present results show that people were most critical precisely when they were partially identifiable. Anonymity increased the number of critical remarks only in settings in which people were visually co-present (hence identifiable to an audience), not when they were completely anonymous. Hence, the present findings suggest that deindividuation did not cause anonymity's effect on critical remarks.

If deindividuation did not cause the increase in critical remarks, the question is what did? In answering this question, it is noteworthy that none of these studies examined what people were critical about. Thus, critique could have conveyed that people in anonymous conditions were dissatisfied with the GDSS used. That this is a reasonable assumption is suggested by anonymity's negative impact on the perceived effectiveness of these systems. This could imply that anonymity does not so much impact on certain psychological processes such as deindividuation, but that participants perceive anonymity as ineffective and possibly irritating when people are co-present in the same decision room. That this is not an unlikely explanation for the increased volume of critical remarks in anonymous GDSSs is apparent from a

post-hoc analysis that the authors conducted. The correlation between perceived effectiveness and the number of critical remarks was near-perfect, $r(65) = -0.97$, $k = 3$. This correlation indicates that more negative impressions due to anonymous GDSSs coincided with a large volume of critical remarks, although the small number of studies does not allow very definite conclusions. In sum, the findings suggest that anonymous participants' critical stance is not due to deindividuation, but may be caused by participants' dissatisfaction with the effectiveness of anonymous GDSSs.

4.3. *Reconceptualizing decision-making and impacts of GDSSs*

One of the problems characterizing many studies of group processes, and experimental studies of GDSS effects in particular, is that groups are assumed to operate in a social vacuum (Tajfel 1972). Studies are conducted and reported as if groups have no history, no background, and no purpose beyond their meeting. Yet, it seems likely that the participants in these studies (typically managers, and business or undergraduate students), will approach the experiments with clear sets of norms regarding appropriate behaviour for group interaction, participation in scientific research, and usage of computer systems. Moreover, group norms emerge in any group and in any given experimental study, and these are likely to be crucially influenced by contextual factors such as the precise instructions given to the participants and the conditions under which interaction occurs (i.e. characteristics of the GDSS). Previous research within and outside computer-mediated settings attests to the importance of these minimal contextual factors, such as systems design, on the nature of group norms and subsequent group processes (Lea and Giordano 1997, Postmes and Spears 1998, Postmes *et al.* 1998a).

The importance of group norms for a variety of group processes is becoming increasingly evident, even in contexts such as GDSSs that have been designed with the explicit purpose of removing social influences from group decision-making. For example, Jessup and George (1997) report several cases in which groups in their studies of anonymous group decision support acted in unanticipated and 'problematic' ways. In one study, which involved the help of a confederate, group members collectively reacted against the confederate's noncommittal stance—in effect collectively sabotaging the success of the manipulation. In a second study, groups 'degenerated into complete silliness... At first, one group member contributed silly comments... Eventually a second member engaged in the frivolous commentary. The third group member pleaded that the other two group members return to the task, but then gave in, joining in the frivolity' (Jessup and George 1997: 400). Thus, norms seem to have rooted in several groups who had to deal with anonymous GDSSs, despite the assumed capacity of this setting to minimize social and normative influence.

The authors think that the operation of social norms in decision-making groups (including those using GDSSs) should not be seen as an unwanted side-effect occurring only in certain problematic and undesirable situations. Rather, it is believed that the impact of social norms is central to group decision-making, and that the importance of normative influence is only accentuated by the fact that it plays a role even in settings designed to annihilate it. Others have acknowledged the importance of social influences in shaping GDSS usage. For example, adaptive structuration theory elaborates on how groups draw on group spirit and structural features to create social structures during interaction, and thereby produce and

reproduce their own customized structures and validate them through use (DeSanctis and Poole 1994). However, despite the advances made in charting the diversity of technology uses that may result from processes such as adaptive structuration and social construction, formulation of a testable theoretical framework of how social context and technology interact to produce certain *predictable* outcomes remains a challenge for the benefit of GDSS use and research. The remainder of this paper outlines what the authors have learned in the field of CMC about this interaction of technology characteristics and social factors (especially norms), in an attempt to make more specific predictions about the impact of GDSSs on the decision-making process.

The exploration of the impact of GDSSs on decision-making begins by reiterating some of the findings in previous research (Reicher *et al.* 1995, Postmes *et al.* 1998a). These review studies have shown that anonymity does not preclude normative influence in groups: under some conditions anonymity accentuates normative influence, under others its influence is minimal, and under yet others anonymity undermines social influence. Thus, there is no straightforward linear relation between anonymity and group performance, and this is partly due to the different psychological effects that anonymity may have. As mentioned in the introduction, it is believed that part of the reason for anonymity's mixed effects is that anonymity has an impact on two fundamentally different processes: depersonalization and accountability. Both processes have been described and researched in the framework of the Social Identity model of Deindividuation Effects (SIDE; Lea and Spears 1991, Spears and Lea 1992, 1994, Reicher *et al.* 1995, Postmes *et al.* 1998a).

Depersonalization refers to the tendency to perceive the self and others not as *individuals* with a range of idiosyncratic characteristics and ways of behaving, but as representatives of social groups or overarching social categories made salient during interaction (Turner 1987). In other words, compared to conditions in which individuals are identified and identifiable, anonymity may depersonalize the *cognitive perceptions* of self and others in the group, and reinforce the salience of their social identity within the group or an overarching social category. This means that under anonymity, normative influence deriving from salient social identities may be accentuated. Importantly, whether this occurs depends on the *a priori* availability and salience of a social identity in the group (Spears *et al.* 1990). Moreover, the content group of the group's norms determines what influence is exerted (Postmes *et al.* 1998b). So, if no common group identity is available, or if group performance is not prescribed by any group norms, the impact of depersonalization on group performance is expected to be minimal. If, however, a common identity is available that has clear implications for group behaviour or decision preferences, the group's norms will have a stronger influence on group performance when the group members are depersonalized, as is for example the case in most GDSS sessions.

The second impact of anonymity is on accountability. Accountability is usually associated with fear of reprisals by the group, which may follow an anti-normative action. This means that the cover of anonymity (as it may be available in CMC and in GDSSs) could provide people with the *strategic liberty* to ignore undesirable outside influences (Reicher and Levine 1994a,b, Spears and Lea 1994). So the impact of accountability is in many respects the opposite of depersonalization. Accountability pressures are smaller in anonymous settings, for example in most GDSS sessions, and therefore normative influence is likely to be diminished in those settings. Conversely, when group members are accountable

(for example when they are fully identified) their freedom is restrained by the sanctioning power of the group.

The crucial distinction between the two processes, and the key to predicting when which process will dominate, is the group members' relation to the social norms in question. If the social norms are seen as 'in-group' norms, then this implies that being influenced by them is not seen as negative and undesirable. In this case normative influence is not an outside influence, but an influence that is motivated by common group membership, and subsequent internalization of group norms as a part of an individual's social identity. The salience of this social identity is not diminished by anonymity, but may instead be accentuated due to decreased perceptions of individual differences within the group (Spears and Lea 1992). In contrast, if group norms are not subscribed to (for example because the group is seen as an out-group, or there is disagreement within the group, or personal identity prevails) then their social influence may be seen as undesirable. Hence, the influence of undesirable group norms depends on coercion by others, and anonymity provides the opportunity to resist coercion (Reicher and Levine 1994a, Spears and Lea 1994). These strategic consequences of anonymity result in a potential reduction of the influence of the group over the individual. This process is similar to some effects of anonymity hypothesized in other theories of GDSSs (Jessup *et al*. 1990b, Valacich *et al*. 1992b).

The dual consequences of anonymity proposed by the model may help to account for some of the effects of anonymity in GDSSs that were described above. More important than the specifics of this model for GDSS technology, however, is that it reflects a concern with the social process in groups and the origin of social influence, rather than a description of anonymity on group performance (Postmes *et al*. 1999). The importance of group members' identity, group norms, aspects of the social context, and of the physical context (i.e. technology used) should be acknowledged. None of these factors in isolation is sufficient to study group performance. Identity, norms and the social and physical context will interact in complex ways to produce a variety of group processes. In addition, it is important to stress the dynamics of these group processes. With regard to group norms, for example, it is not enough to presuppose the existence of group norms *a priori*. Indeed, group norms will emerge over the course of interaction as a function of group members' common history and identity, their expressed views, a search for distinctiveness from other groups (see Postmes *et al*. in press for a discussion), and influential contextual cues in the experiment, their task, or in the procedures imposed by the system used (Postmes and Spears 1998). In sum, the social influences that shape a group decision will—almost by definition—emerge over the course of interaction.

In conclusion, then, it is advocated that future research charts the impact of different forms of decision support and anonymity on group performance. However, in doing so it should take into account more than just anonymity or certain task properties. It is proposed that aspects of group members' identity, the group's norms and the social and physical context of interaction should be jointly considered, and that their influence should be observed in group processes as they dynamically evolve, not merely in the outcomes of it. In addition, the psychological processes such as accountability and depersonalization that may underlie the impacts of technology deserve systematic examination. Regardless of the approach taken, however, the present findings clearly speak to the importance of developing new theoretical frameworks for GDSS effects and group performance more generally. The lack of consistent effects of anonymity on decision quality or the decision-

making process challenges the prevalent assumptions about group decision-making and the nature of groups, which are at the heart of GDSS design. The authors failed to find support for assumptions about group performance that define social influence as a one-way street of (mostly negative) impacts of the group on its members. This failure accentuates that we need to reconceptualize the mutual influence of the group and the individual in the decision-making process.

Acknowledgements

This research was supported by a fellowship from the Royal Netherlands Academy of Arts and Sciences to Tom Postmes, by project grants to Martin Lea from the British Council/NWO UK-Dutch Joint Scientific Research Programme and the Economic and Social Research Council ('Virtual Society?' research programme), and by a project grant of the Engineering and Physical Sciences Research Council to Lea and Postmes.

The School for Communication, Information and Library Studies of Rutgers University is thanked for its hospitality and for providing the facilities that enabled Tom Postmes to undertake this research.

References

Anonymous. 1998, To reveal or not to reveal: a theoretical model of anonymous communication, *Communication Theory*, **8,** 381–407.

Applegate, L. M., Konsynski, B. R. and Nunamaker, J. F., Jr. 1986, A group decision support system for idea generation and issue analysis in organizational planning, *Proceedings of the Conference on Computer Supported Cooperative Work*, (Austin, TX: ACM Press), 16–34.

Asch, S. E. 1952, *Social Psychology* (Englewood Cliffs, NJ: Prentice-Hall).

Benbasat, I., Lim, F. J. and Rao, V. S. 1995, A framework for communication support in group work with special reference to negotiation systems, *Group Decision and Negotiation*, **4,** 135–158.

Benbasat, I. and Lim, L. H. 1993, The effects of group, task, context, and technology variables on the usefulness of group support systems: a meta-analysis of experimental studies, *Small Group Research*, **24,** 430–462.

Briggs, R. O., Nunamaker, J. F., Jr. and Sprague, R. H., Jr. 1998, 1001 Unanswered research questions in GSS, *Journal of Management Information Systems*, **14,** 3–21.

Brown, R. 1988, *Dynamics within and between groups*, (Oxford: Blackwell).

Chun, K. J. and Park, H. K. 1998, Examining the conflicting results of GDSS research, *Information and Management*, **33,** 313–325.

Cohen, J. 1977, *Statistical Power Analysis for the Behavioral Sciences* (New York: Academic Press).

Connolly, T., Jessup, L. M. and Valacich, J. S. 1990, Effects of anonymity and evaluative tone on idea generation in computer-mediated groups, *Management Science*, **36,** 689–703.

Cooper, H. and Hedges, L. V. 1994a, *Handbook of Research Synthesis*, (New York: Sage).

Cooper, H. and Hedges, L. V. 1994b, Potentials and limitations of research synthesis, in H. Cooper and L. V. Hedges (eds), *Handbook of Research Synthesis* (New York: Sage), 521–529.

Cooper, W. H., Gallupe, R. B., Pollard, S. and Cadsby, J. 1998, Some liberating effects of anonymous electronic brainstorming, *Small Group Research*, **29,** 147–178.

Delbecq, A. L., Van de Ven, A. H. and Gustafson, D. H. 1975, *Group techniques for program planning* (Glenview, IL: Scott, Foresman).

Dennis, A. R. and Gallupe, B. R. 1993, A history of group support systems' empirical research: lessons learned and future directions, in L. M. Jessup and J. S. Valacich (eds.), *Group Support Systems: New Perspectives* (New York: Macmillan), 59–77.

Dennis, A. R., George, J. F., Jessup, L. M., Nunamaker, Jr J. F. and Vogel, D. R. 1988, Information technology to support electronic meetings, *MIS Quarterly*, **12,** 591–624.

DeSanctis, G. and Gallupe, R. B. 1987, A foundation for the study of group decision support systems, *Management Science*, **33,** 589–609.

DeSanctis, G. and Poole, M. S. 1994, Capturing the complexity in advanced technology use: Adaptive structuration theory, *Organization Science*, **5,** 121–147.

Diener, E. 1977, Deindividuation: causes and consequences, *Social Behavior and Personality*, **5,** 143–155.

Forsyth, D. R. 1999, *Group Dynamics*, 3rd ed. (Pacific Grove, CA: Brooks/Cole).

Fulk, J. and Collins-Jarvis, L. in press, Research on the productivity of mediated meetings, in L. L. Putnam and F. M. Jablin (eds), *New Handbook of Organizational Communication* (Newbury Park, CA: Sage).

George, J. F., Easton, G. K., Nunamaker, J. F., Jr. and Northcraft, G. B. 1990, A study of collaborative group work with and without computer-based support, *Information Systems Research*, **1,** 394–415.

Haslam, S. A. 2000, *Psychology in Organizations: The Social Identity Approach* (London: Sage).

Hayne, S. C. and Rice, R. E. 1997, Attribution accuracy when using anonymity in group support systems, *International Journal of Human-Computer Studies*, **47,** 429–452.

Hiltz, S. R. and Turoff, M. 1978, *The Network Nation* (Cambridge, MA: MIT Press).

Hiltz, S. R., Turoff, M. and Johnson, K. 1989, Experiments in group decision making, 3: Disinhibition, deindividuation, and group processes in pen name and real name computer conferences, *Decision Support Systems*, **5,** 217–232.

Huber, G. P. 1984, Issues in the design of group decision support systems, *MIS Quarterly*, **8,** 195–204.

Janis, I. L. 1982, *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*, 2nd ed. (Boston, MA: Houghton Mifflin).

Jessup, L. M. 1989, The deindividuating effects of anonymity on automated group idea generation, (Unpublished doctoral dissertation, University of Arizona, Tucson, AZ); *Dissertation Abstracts International*, **50–11A**, 3655.

Jessup, L. M., Connolly, T. and Galegher, J. 1990a, The effects of anonymity on GDSS group processes with an idea-generating task, *MIS Quarterly*, **14,** 313–321.

Jessup, L. M., Connolly, T. and Tansik, D. A. 1990b, Toward a theory of automated group work: the deindividuating effects of anonymity, *Small Group Research*, **21,** 333–348.

Jessup, L. M. and George, J. F. 1997, Theoretical and methodological issues in group support systems research: Learning from groups gone awry, *Small Group Research*, **28,** 394–413.

Jessup, L. M. and Tansik, D. A. 1991, Group decision making in an automated environment: the effects of anonymity and proximity with a group decision support system, *Decision Sciences*, **22,** 266–279.

Kiesler, S., Siegel, J. and McGuire, T. W. 1984, Social psychological aspects of computer-mediated communication, *American Psychologist*, **39,** 1123–1134.

Kraemer, K. L. and Pinsonneault, A. 1990, Technology and groups: assessments of the empirical research, in J. Galegher, R. E. Kraut and C. Egido (eds), *Intellectual teamwork: social foundations of cooperative work* (Hillsdale, NJ: Lawrence Erlbaum Associates), 373–404.

Lea, M. and Giordano, R. 1997, Representations of the group and group processes in CSCW research: a case of premature closure?, in G. Bowker, S. L. Star, W. Turner and L. Gasser (eds), *Social Science, Technical Systems and Cooperative Work* (Mahwah, NJ: Erlbaum), 5–25.

Lea, M. and Spears, R. 1991, Computer-mediated communication, de-individuation and group decision-making. Special Issue: Computer-supported cooperative work and groupware, *International Journal of Man Machine Studies*, **34,** 283–301.

Lea, M., O'Shea, T., Fung, P. and Spears, R. 1992, 'Flaming' in computer-mediated communication: observations, explanations, implications, in M. Lea (ed.), *Contexts of Computer-mediated Communication* (Hemel Hempstead: Harvester Wheatsheaf), 30–65.

Linstone, H. A. and Turoff, M. J. 1975, The Delphi method: techniques and applications (Reading, MA: Addison-Wesley).

Matheson, K. and Zanna, M. P. 1988, The impact of computer-mediated communication on self-awareness, *Computers in Human Behavior*, **4,** 221–233.

McLeod, P. L. 1992, An assessment of the experimental literature on electronic support of group work: results of a meta-analysis. Special Issue: Computer-supported cooperative work, *Human Computer Interaction*, **7,** 257–280.

McLeod, P. L., Baron, R. S., Marti, M. W. and Yoon, K. 1997, The eyes have it: Minority influence in face-to-face and computer-mediated group discussion, *Journal of Applied Psychology*, **82,** 706–718.

Miranda, S. M. 1994, Avoidance of groupthink: meeting management using group support systems, *Small Group Research*, **25,** 105–136.

Nunamaker, J. F., Jr., Applegate, L. M. and Konsynski, B. R. 1987, Facilitating group creativity: experience with a group-decision support system, *Journal of Management Information Systems*, **3,** 5–19.

Nunamaker, J. F., Jr., Briggs, R. O., Mittleman, D. D., Vogel, D. R. and Balthazard, P. A. 1997, Lessons from a dozen years of group support systems research: a discussion of lab and field findings, *Journal of Management Information Systems*, **13,** 163–207.

Nunamaker, J. F., Jr., Dennis, A. R., George, J. F., Valacich, J. S. and Vogel, D. R. 1991, Electronic meeting systems to support group work: theory and practice at Arizona, *Communications of the ACM*, **34,** 40–61.

Nunamaker, J. F., Jr., Dennis, A. R., Valacich, J. S., Vogel, D. R. and George, J. F. 1993, Group support systems research: experience from lab and field, in L. M. Jessup and J. S. Valacich (eds), *Group Support Systems: New Perspectives* (New York: Macmillan), 123–145.

Pinsonneault, A. and Heppel, N. 1998, Anonymity in group support systems research: a new conceptualization, measure, and contingency framework, *Journal of Management Information Systems*, **14,** 89–108.

Postmes, T. and Spears, R. 1997, Quality of decisions, group norms and social identity: biased sampling or sampled biases, paper presented at the Fifth Munster Workshop on the Social Identity Approach, Rothenberge, Germany.

Postmes, T. and Spears, R. 1998, Deindividuation and anti-normative behavior: a meta-analysis, *Psychological Bulletin*, **123,** 238–259.

Postmes, T., Spears, R. and Lea, M. 1998a, Breaching or building social boundaries? SIDE-effects of computer-mediated communication, *Communication Research*, **25,** 689–715.

Postmes, T., Spears, R. and Lea, M. 1999, Social identity, group norms, and 'deindividuation': lessons from computer-mediated communication for social influence in the group, in N. Ellemers, R. Spears and B. Doosje (eds), *Social identity: Context, Commitment, Content* (Oxford: Blackwell), 164–183.

Postmes, T., Spears, R. and Lea, M. in press, The formation of group norms in computer-mediated communication, *Human Communication Research*.

Postmes, T., Spears, R., Sakhel, K. and De Groot, D. 1998b, *Social influence in computer-mediated groups: the effects of anonymity on group behavior*, Manuscript submitted for publication.

Prentice-Dunn, S. and Rogers, R. W. 1989, Deindividuation and the self-regulation of behavior, in P. B. Paulus (ed.), *The Psychology of Group Influence* (Hillsdale, NJ: Lawrence Erlbaum), 86–109.

Reicher, S. and Levine, M. 1994a, Deindividuation, power relations between groups and the expression of social identity: the effects of visibility to the out-group, *British Journal of Social Psychology*, **33,** 145–164.

Reicher, S. and Levine, M. 1994b, On the consequences of deindividuation manipulations for the strategic communication of self: Identifiability and the presentation of social identity, *European Journal of Social Psychology*, **24,** 511–524.

Reicher, S. D., Spears, R. and Postmes, T. 1995, A social identity model of deindividuation phenomena, in W. Stroebe and M. Hewstone (eds), *European Review of Social Psychology* (Chichester: Wiley), 161–198.

Rosenthal, R. 1991, *Meta-analytic Procedures for Social Research* (Newbury Park, CA: Sage).

Scott, C. R. 1994. Organizational identification and group decision support systems: a situated action theory of identification shifts, Unpublished doctoral dissertation, Arizona State University, Tempe, Arizona.

SHADISH, W. R. and HADDOCK, C. K. 1994, Fixed effects models, in H. Cooper and L. V. Hedges (eds), *Handbook of Research Synthesis* (New York: Sage), 261–284.

SHORT, J. A., WILLIAMS, E. and CHRISTIE, B. 1976, *The Social Psychology of Telecommunications* (Chichester: Wiley).

SOSIK, J. J. 1997, Effects of transformational leadership and anonymity on idea generation in computer-mediated groups, *Group & Organization Management*, **22,** 460–487.

SOSIK, J. J., AVOLIO, B. J. and KAHAI, S. S. 1997, Effects of leadership style and anonymity on group potency and effectiveness in a group decision support system environment, *Journal of Applied Psychology*, **82,** 89–103.

SPEARS, R. and LEA, M. 1992, Social influence and the influence of the 'social' in computer-mediated communication, in M. Lea (ed.), *Contexts of Computer-Mediated Communication* (Hemel Hempstead: Harvester Wheatsheaf), 30–65.

SPEARS, R. and LEA, M. 1994, Panacea or panopticon? The hidden power in computer-mediated communication, *Communication Research*, **21,** 427–459.

SPEARS, R., LEA, M. and LEE, S. 1990, De-individuation and group polarization in computer-mediated communication, *British Journal of Social Psychology*, **29,** 121–134.

STEINER, I. D. 1972, *Group Process and Productivity* (New York: Academic Press).

STROEBE, W. and DIEHL, M. 1994, Why groups are less effective than their members: on productivity losses in idea-generating groups, in W. Stroebe and M. Hewstone (eds), *European Review of Social Psychology* (Chichester: Wiley), 271–303.

TAJFEL, H. 1972, Experiments in a vacuum, in J. Israel and H. Tajfel (eds), *The Context of Social Psychology* (London: Academic Press), 69–119.

TURNER, J. C. 1987, A self-categorization theory, in J. C. Turner, M. A. Hogg, P. J. Oakes, S. D. Reicher and M. S. Wetherell (eds), *Rediscovering the Social Group: A Self-Categorisation Theory* (Oxford: Blackwell), 42–67.

TURNER, J. C. 1991, *Social Influence* (Milton Keynes: Open University Press).

TURNER, J. C., HOGG, M. A., OAKES, P. J., REICHER, S. D. and WETHERELL, M. S. 1987, *Rediscovering the Social Group: A Self-categorization Theory* (Oxford: Blackwell).

TUROFF, M. and HILTZ, S. R. 1982, Computer support for group vs. individual decisions, *IEEE Transactions on Communication*, **30,** 82–90.

VALACICH, J. S., DENNIS, A. R. and NUNAMAKER, J. F., Jr., 1991, Electronic meeting support: the groupsystems concept. Special issue: Computer-supported cooperative work and groupware: I, *International Journal of Man Machine Studies*, **34,** 261–282.

VALACICH, J. S., DENNIS, A. R. and NUNAMAKER, J. F., Jr., 1992a, Group size and anonymity effects on computer-mediated idea generation, *Small Group Research*, **23,** 49–73.

VALACICH, J. S., JESSUP, L. M., DENNIS, A. R. and NUNAMAKER, J. F., Jr., 1992b, A conceptual framework of anonymity in group support systems, *Group Decision and Negotiation*, **1,** 219–241.

VALACICH, J. S., PARANKA, D., GEORGE, J. F. and NUNAMAKER, J. F., Jr., 1993, Communication concurrency and the new media: a new dimension for media richness, *Communication Research*, **20,** 249–276.

WALTHER, J., ANDERSON, J. F. and PARK, D. W. 1994, Interpersonal effects in computer-mediated interaction: a meta-analysis of social and anti-social communication, *Communication Research*, **21,** 460–487.

ZIMBARDO, P. G. 1969, The human choice: individuation, reason, and order vs. deindividuation, impulse and chaos, in W. J. Arnold and D. Levine (eds), *Nebraska Symposium on Motivation* (Lincoln, NE: University of Nebraska Press), 237–307.

Appendix: Overview of major variables for each test included

Study[a]	Population	Dependent variable	*r*	*N*	*N* Groups	*Z*
1	Business school students	N Original solutions	0.26	72	23	1.23
2	Undergraduates	N Original solutions	0.37	240	60	2.83
3	Undergraduates	Number of alternatives	0.02	180	30	0.13
5	Business school students	N Solutions	0.03	71	–	0.11
6	Business school students	N Solutions	0.07	80	–	0.33
7	Business school students	N Original solutions	0.00	80	20	0.00
8	Business school students	N Original solutions	−0.05	80	20	−0.23
9	Undergraduate and graduate students	Minority argument count	0.50	156	39	3.15
10	Undergraduates	Minority argument count	0.10	128	32	0.56
11	Undergraduate students	N Original solutions	−0.09	159	36	−0.52
1	Business school students	Group decision quality	0.16	72	23	0.78
3	Undergraduates	Decision quality	−0.27	180	30	−1.46
5	Business school students	Quality of suggestions	0.09	71	–	0.39
6	Business school students	Quality of suggestions	0.08	80	–	0.34
9	Undergraduate and graduate students	Group decision quality	0.01	156	39	0.07
10	Undergraduates	Group decision quality	0.14	128	32	0.80
11	Undergraduate students	Group report quality	−0.13	159	36	−0.80
12	Business school students	Group decision quality	−0.13	126	22	−0.62
1	Business school students	Overall satisfaction	−0.12	72	23	−0.60
2	Undergraduates	Overall satisfaction	0.10	240	60	0.79
3	Undergraduates	Satisfaction	−0.09	180	30	−0.49
7	Business school students	Overall satisfaction	0.01	80	20	0.03
10	Undergraduates	Overall satisfaction	0.05	128	32	0.29
11	Undergraduate students	Perceived performance	0.14	159	36	0.83
12	Business school students	Overall satisfaction	−0.48	126	22	−2.27
1	Business school students	Rated effectiveness (averaged 3)	−0.38	72	23	−1.81
7	Business school students	Rated effectiveness (averaged 5)	−0.02	80	20	−0.07
12	Business school students	Rated effectiveness	−0.40	126	22	−1.88
1	Business school students	Total N statements	0.35	72	23	1.67
4	Middle-level managers	Total N statements	0.13	60	12	0.46
5	Business school students	Total N statements	−0.03	71	–	−0.11
6	Business school students	Total N statements	0.04	80	–	0.16
7	Business school students	Total N statements	0.26	80	20	1.17
8	Business school students	Total N statements	0.66	80	20	2.95
10	Undergraduates	Total arguments	0.00	128	32	0.00
12	Business school students	Total N statements	0.23	126	22	1.07
1	Business school students	Critical remarks	0.50	72	23	2.40
7	Business school students	Critical remarks (averaged 2)	−0.11	80	20	−0.49
8	Business school students	Critical remarks (averaged 2)	0.48	80	20	2.12
9	Undergraduate and graduate students	Critical remarks (negative with respect to minority)	0.79	156	39	4.92
12	Business school students	Critical remarks	0.69	126	22	3.25

A dash (–) indicates that a characteristic could not be coded. [a]1= Connolly *et al.* (1990); 2= Cooper *et al.* (1998); 3= George *et al.* (1990); 4= Hiltz *et al.* (1989); 5= Jessup (1989), Study 1; 6= Jessup (1989), Study 2; 7= Jessup and Tansik (1991); 8= Jessup *et al.* (1990a); 9= McLeod *et al.* (1997); 10= Postmes and Spears (1997); 11= Sosik *et al.* (1997); 12= Valacich *et al.* (1992a).