**Introduction**

Observational research of social interaction has been affected profoundly by technology as it has evolved from film, to analogue tape, to digital and from expensive and cumbersome to inexpensive and portable recording devices (Bakeman & Gottman 1997). In many disciplines where the study of communication, conversation and social interaction is of concern (eg social psychology, psychiatry, anthropology, linguistics, sociology, ethology), the ability to study social interaction through repeated viewings of video and audio recordings has proven immensely useful (Bull 2002). The consequences for what could be called a revolution in recording technology have been profound for the way we think about human communication (Kendon 1982); this revolution has affected quantitative and qualitative approaches alike (Jacobs,
Kawanaba & Stigler 1999). Human interaction is essentially a dynamic process that unfolds in time. Technology that allows us not just to view interaction, as we do when viewing live, but to view it repeatedly (literally, to review) has been invaluable to scholars of interaction.

We will discuss quantitative/qualitative issues from our point of view as observational researchers who mainly use quantitative analysis. We will focus on data collection because, in our view, critical issues between qualitative and quantitative approaches are largely concentrated in this research step. For quantitative approaches we will reference mainly our past studies and research (Bakeman 2000; Bakeman & Gnisci 2005; Bakeman & Gottman 1997; Bakeman & Quera 1995a 1995b; Gnisci 2005; Gnisci & Bakeman 2007; Quera, Bakeman & Gnisci 2007) and for qualitative approaches we will reference classical contributions that range from ethnography, ethnomethodology and ethogeny to conversation and discourse analysis (Edwards & Potter 1993; Drew & Heritage 1992; Harré 1979; Harré & Secord 1972; Heritage 1984; Goodwin & Duranti 1992; O’Barr 1982; Sacks, Schegloff & Jefferson 1974; Schegloff 1993).

Throughout, we focus on the uses each approach has for the other. We begin by describing the usefulness of qualitative research for quantitative researchers and then list and discuss some common criticisms qualitative researchers have concerning quantitative research. After having briefly described the quantitative approach to interaction that we pursue, that is sequential analysis, we present two examples of it, which show how the results of quantitative observational research can inform and guide subsequent qualitative research. One is based on time series analysis, the other on similarity maps and both represent concrete possibilities of integration between the two approaches.

The usefulness of qualitative research for quantitative researchers
Qualitative research is often viewed as both a precursor to and a partner for quantitative research (eg O’Barr & Lind 1981). Its results not only stimulate the development of theories about specific phenomena, but also aid in development of observational schemes to measure those phenomena.

Qualitative observational research applies an inductive method to the comprehension of interaction, using such methods as participant observation, conversation and discourse analysis, ethogeny, ethnography and so on. The results of such research often stimulate subsequent quantitative research (an example is provided in the next paragraph). Qualitative research aims to obtain a detailed and deep comprehension of the phenomenon studied, formulating descriptions, possible explanations and hypotheses. However, when rigorous experimental methods are applied to the study of social interaction, as social psychology often attempts to do, important real-world matters may be overlooked. Each approach has risks: studies may be based on a too narrowly constructed a view of reality, on one hand, or based on too abstract a construction of the world without sufficient empirical grounding, on the other (Lewin 1944). From this point of view, qualitative studies can and often do provide the quantitative world a needed breath of fresh air.

An excellent example of quantitative research stimulated by qualitative results is provided by development of the face model used to analyse televised political interviews (Bull & Elliott 1998), which postulates that the main concern for politicians engaged in a public situation is to avoid losing face (Bull, Elliott, Palmer & Walker 1996). The politicians not only have to appear competent and prepared on every possible issue, they also have to try not to disappoint their electorate, annoy different possible voters, contradict statements previously made by themselves and their colleagues, or damage the image of either their party or significant others (Bull 2002; Gnisci 2008). In such communicative conflict situations, shrewd politicians use minimal, elaborated, implicational, or no-reply answers to protect themselves and their colleagues, or damage the image of either their party or significant others (Bull & Mayer 1993); whereas interviewers, attempting to force politicians into an avoidance–avoidance conflict (Lewin 1938; Bave-
Blending qualitative and quantitative analyses in observing interaction

las et al 1990), use face-threatening and coercive questions. Based on this conceptual analysis, three different ‘code and count’ category systems were developed, one for threatening questions, another for coercive questions and the last for responding/not responding to the questions (Bull 1994, 2003).

One of the primary influences on this model was Goffman’s (1955) face theory. Goffman’s theory was developed for explaining the ways in which people present themselves in everyday life, support or challenge the claims of others, and, in particular, deal with challenges to their identity perpetrated by others (Bull 2002). In his first article on face-work he exemplified a number of strategies for both avoiding threats to face and repairing possible damages to face. Goffman was primarily a theorist who put forward a conceptual framework for studying social interaction (Bull 2002). Although Goffman considered himself a ‘human ethologist’ (1971), his methods were uniquely his own, made use of his exceptional observational capacities and freely ranged from participant observation of social encounters to thoughtful reading of etiquette books and advertisements (Bull 2002). In particular, his work was not based on systematic and detailed analysis of recorded material.

In sum, there is a profound influence of Goffman’s face theory (1955), based on qualitative methodology, on Bull’s and associates’ face model of political interviews, a model based on the use of category systems and inferential analysis. We can easily track the lines that connect Goffman’s qualitative work to the quantitative research realised by Bull’s research group. Goffman’s face theory guided Brown and Levinson (1978, 1987), who in their politeness theory focused on positive and negative face. Jucker (1986), discussing the politeness theory on politicians’ news interviews, identified 13 different ways in which the face of a politician can be threatened in the course of the interview. Bull and associates (Bull et al 1996) found these categories too general for studying specific question-answer exchanges and expanded the list to 19 that, in turn, could be organised in three superordinate and not mutually exclusive categories of questions: ones that threaten directly the face of the interviewed politician, his or her political party, or significant others. A hypotheses-testing study then applied this category system to a set of 18 interviews from the 1992 British General Elections and eventually to many others.

A second example of the influence of qualitative on quantitative research is provided by the Interruption Coding System (ICS), a comprehensive classification of turn-taking (Roger, Bull & Smith 1988) that is based on a well known, seminal paper by Sacks, Schegloff and Jefferson (1974). In this paper the mechanism of alternation of turns was extensively studied using a detailed empirical analysis of phone calls to a suicide prevention center. The calls were transcribed in considerable detail, which let the investigators identify the basic features of turn alternation in conversation and ultimately propose a system of rules that described how turn-taking is organised (for the development of ICS see also Bull 2003: 82–87). Again, qualitative work provided basic insights for subsequent quantitative hypotheses-testing research. 1

Qualitative research is important, not just when formulating hypotheses, but during other phases of quantitative observational research as well. Many handbooks describe these research phases (ie Reis & Judd 2000; Eid & Diener 2006). Here we wish only to state that qualitative analysis can contribute during various steps of the research process: from the planning of research to data collection; establishing reliability and (particularly, content) validity; the data analysis stage and interpretation and communication of results. In particular, it plays a vital role in the formation of hypotheses.

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1 An interesting example of the blended use of quantitative and qualitative sequential research that the reader may wish to consult is Müntigl and Turnbull's (1998) study of facework in arguing. Another instructive example is O'Barr and Lind's (1981; O'Barr 1982) ethnographic and experimental studies on linguistic styles in legal examinations.
of hypotheses and the development of coding systems and it is essential in new areas of investigation (Bakeman & Gottman 1997).

Some common qualitative criticisms of quantitative research and some answers
Fruitful cooperation between qualitative and quantitative approaches can come from two sources: from research that integrates the approaches and from discussion of what we think are misunderstandings, false beliefs even, that each approach has toward the other. Here we focus primarily on qualitative critiques of quantitative approaches because, in our experience, they often serve as obstacles to reciprocal comprehension. We emphasise matters that often concern qualitative researchers: quantitative researchers’ unit of analysis and their behavioral coding schemes, the issue of ‘pre-defined’ categories, the concept of sequential context, the problem of how to grasp the complexity of social interaction and finally the role of transcripts in observational research.

The ‘natural’ units of analysis
According to many qualitative researchers a basic concern is that quantitative researchers’ units of analysis do not correspond to how people organise themselves during interaction and the coding categories do not reflect how participants in fact parse their interaction (Edwards & Potter 1992; Goodwin & Duranti 1992). They argue that, in our understanding of interaction, we should privilege the interpretations, the meanings and the orientations of the participants (Schegloff 1997). In qualitative terms, the unit that organises the interaction and the behavioral categories that describe interaction in quantitative studies are not ‘natural’. Consider first the issue of unit.

Some misunderstandings can arise from confusing the coding unit with the descriptive statistics derived from coding, such as, eg rates, mean durations, etc. The coding unit in an interactional study is the ‘entity’ to which coders, following rules, assign a particular category (Stevens 1946). Descriptive statistics are elaborations of the data collected. Therefore, they concern data analysis, not data collection. Typically the entity coded is a behavior, but often coders are asked not just to assign a code to a behavior, but also to note its onset and offset time as well. Thus the coding unit would be a behavior but the measurement unit one of time (eg a second). Measurement and coding units are often confused, probably because in some cases they overlap (eg when time intervals are coded), but they are different concepts.

Qualitative researchers often call the units they use ‘natural’ because they reflect the organisation people give to interaction. A striking example is provided by conversational analysis where transcripts are often segmented into turns-of-talk (Sacks et al 1974). However, units as turn or speech are used also by quantitative analysts (Gottman 1979; a similar term is ‘thought unit’). Gottman (1983), for example, used such units in a quantitative way in his well known study on how children become friends. As a further refinement, each natural unit can be coded on more than one dimension (Bakeman & Gottman 1997, term this cross-classifying events), which we regard as important because it allows the use of modeling strategies for analysing data (eg Gnisci 2005, 2008 in press).

The issue of ‘pre-defined’ categories
Beyond the coding unit, behavioral codes or categories are sometimes criticised as being ‘pre-defined’ (Peräkylä 2004) by qualitative analysts. Psathas (1995), for example, considers coding systems as arbitrary and reductive, fixed and abstract; they distort behavior by forcing it to fit preconceived categories and do not give sufficient consideration to the context and the meaning of interaction. From a qualitative point of view, observers should not impose their own preconceived categories onto reality, but, on the contrary, should make use of the way people categorise themselves as manifested in their own talk (Bull 2002). Here we will not question qualitative assumptions, asking eg by what method
qualitative analysts claim that they are not imposing categories but merely labeling what can be observed to exist, a criticism that Billig (1999) addresses to conversation analysis (see Mey 2001). Aided by Bull’s (2002) discussion of these assumptions, we will try to address what we view as misunderstandings.

We would argue that participants’ categories can be used in a quantitative way. Indeed, researchers can and often do, create ad hoc category systems, that is, systems that are inductively based on the recorded material used in the research that attempt to reflect what participants experience and how they categorise their experience. If the point of view of participants is paramount and a qualitative analyst can grasp it, why cannot a quantitative one do likewise when developing an ad hoc category system? It is worthwhile here to contrast the criticism on pre-defined or preconceived categories (see Psathas 1995) with the vivid description of the beginning of a quantitative observation provided by Bakeman and Gottman (1997: 12):

We do not think that an investigator need have a coding system before collecting data of interest. For example, Gottman began his research on acquaintanceship in children (1983) by collecting tape recordings of children becoming acquainted. He had no idea at first which situations and experimental arrangements were best for collecting data. Although the literature suggested some social processes to study, ... he had little idea how to operationalize these constructs. A great deal of work was necessary before a useful category system was devised. He also found that several different coding systems were necessary to capture different aspects of the children’s interaction.

Bakeman and Gottman then comment: ‘The wonderful thing about observational research is that it maximises the possibility of being surprised’ (1997: 13). Similar words are quoted by Rosenblum (1978) when describing the initial stages of observational research. The deep, rich and detailed qualitative work, often carried out with a kind of ethnographic method by quantitative researchers, Bakeman and Gottman characterise as important hypotheses-generating observation.

True, after development and once the coding phase of a research project begins, quantitative researchers are extremely reluctant to make additional changes to their coding systems because to assure comparability this would require them to recode material previously coded (see Section 2 above). However, this does not mean that their coding systems are ‘pre-defined’ in an absolute sense. The researcher can adapt and modify them in the preliminary phase of qualitative observation, as we have shown; and he/she can modify and improve the categories, their contents and many other features in future research: ‘Coding systems can also change over time’ (Bull 2002: 20), they can be improved to provide a better representation of what they initially were thought to observe. They develop in a Darwinian sense in contrast to the static picture that qualitative analysts sometimes provide of them. The observational capabilities of an analyst during qualitative observation can benefit from previously carried out qualitative observation; likewise with quantitative analysis the use of categories, the coding process and the reflection on these activities and practices in previous research may bring the quantitative researcher to modify, improve and redefine all or part of the category system. Even if initially adopted, a category system can in any case be adapted for future research. Bakeman and Gottman (1997) provide an example of such development, noting how Parten’s (1932) seminal coding scheme for preschool children’s play was first modified by Smith (1978) and then further elaborated by Bakeman and Brownlee (1980).

Two final points: quantitative research is usually well-served when investigators take into account what people feel, how they organise conversation and how they perceive and categorise situations or events in their speech, but this does not necessarily invalidate category systems that are less or not at all participant-oriented. On the contrary, they can be highly informative, precisely
because they are devised by outside observers (Bull 2002). We are not convinced that the only valid view is from the inside.

Moreover, according to Bull (2002), a positive aspect of category systems – one that is often under-appreciated by qualitative researchers – is that, instead of being a hindrance, they can actually aid perception. Indeed, they focus attention on phenomena that scholars in the field have found important both empirically and theoretically. True, when adopted mechanically and uncritically, coding systems can work as blinders, but in general they act as corrective lenses that allow a better view (Bakeman 2000). For this reason category systems are very useful when training observers or professional people in communication skills (Bull 2002); they also provide focus for observers, which can improve their reliability.

The sequential context reflected in the categories

Qualitative researchers sometimes maintain that categorical observation does not take context into consideration, particularly sequential context, that is, what happened just before and immediately after the act that is being considered (Heritage 1984; Peräkylä 2004). This is a common criticism, for example, of Bales’ (1950) Interaction Process Analysis (IPA) that in fact argues for the use of context only when classification is uncertain or dilemmatic (Peräkylä 2004). However, the IPA is a very early category system and over time systems have become increasingly more sophisticated regarding context. For example, one of the basic tenets of the turn-based category system called Initiative-Response Analysis (I-R) is the concept of linguistic context (Linell, Gustavsson & Juvenile 1988). According to the authors, each turn has a retroactive and a proactive strength that links each turn to the previous and following one or ones. From this Bachtinian view (Bakhtin 1986), each turn is both context-determined and context-renewing, a determination which some qualitative authors consider a prerogative of qualitative analysis (Drew & Heritage 1992). In I-R each categorisation requires a shrewd evaluation of the context by the observer.

One well known dispute concerns the category system used by the Linguistic Category Model (Semin & Fiedler 1988, 1991) that, according to qualitative-oriented authors, abstracts words from context and ignores the sequential, contextualised, interaction-oriented nature of talk in interaction (Edwards & Potter 1993, 1999). Although the dispute is far from being resolved, it is worth noting that the authors of the category system reject this claim, pointing out that contextual information is intrinsic to the four basic dimensions on which the category system is built (see Bull 2002). We do not know who is right. However, the fact that context can be intrinsic to the categories is a point worth making. In sum, many category systems now attempt to incorporate the notion of context and the notion that contextualism is a prerogative purely of qualitative methodologies no longer seems tenable (see Dawson, Fischer & Stein 2006); measurement and context can go together.

The complexity of the interaction

Qualitative scholars sometimes question whether quantitative studies can take into consideration the many different levels and aspects of interaction sufficiently. Sometimes, but not always, this is a reasonable concern; but it is not an inherent limitation of quantitative research. For example, what Peräkylä (2004) attributes to the Sacksian research tradition – its focus on discrete aspects of the organisation of interaction such as turn-taking, sequence organisation, repair, choice of words, etc. and their intersection – when contrasting it with the quantitative tradition represented by the Balesian one, could likewise be attributed to many quantitative observational studies.

A good example of a quantitative study that organises its coding systems both hierarchically and sequentially is Bearison and Dorval’s (2001) study of child negotiation. They were primarily interested in those times when children, who had
been instructed to co-invent a board game, entered into what they termed a negotiation episode. They asked observers, working from video records, first to identify episodes of a certain sort before moving on to another level of coding, which in fact is a relatively common and useful coding strategy. The primary coding unit for Bearison and Dorval (2001) consisted of a negotiation episode, but, reflecting their interest in the process of negotiation itself, they asked observers to consider a second unit: the conversational turns individuals take, which are related hierarchically to (ie are nested or embedded within) negotiation episodes. Thus coding proceeded on two levels: first, it detected negotiation episodes, then it identified the conversational turns within them.

Several dimensions of negotiation episodes were of concern, including their topic and their outcome. Topic codes included rules or methods of play and goals or purpose of playing; negotiation outcome codes included unresolved, passive acquiescence, active acceptance, joint compromise and joint elaboration. Additionally, two dimensions of conversational turns were coded: their function and the justification provided. Function codes included initial proposal, counter proposal, disagreement and agreement; justification codes included: none, factual and perspective-taking (justifications that consider the other child’s point of view in some way). The actual study included more dimensions and categories than given here, but these few examples should give some sense of what a realistic and relatively complex set of coding schemes might attend to. Some of these codes may not seem immediately obvious or familiar to all readers, but this only illustrates how codes necessarily reflect the theoretical context of the study they serve, in this case a study of relations between social context and cognitive development based on the works of Piaget and Vygotsky (Mooney 2000). In sum, if a task of conversational analysis is considering larger units than a sentence or utterance ‘conceived as sequences of activity and their component unit turns as turns-within-sequences’ (Drew & Heritage 1992: 18), then considering negotiation episodes and their embedded turns seems a task similar to one usually considered a prerogative of qualitative analysis.

The role of transcripts
Qualitative analysts often complain that quantitative results do not allow the reader to gain a sense of the original data (eg video recordings or transcripts) whereas qualitative data does. Conversation analysts, for example, argue that their transcripts reproduce the sound of conversation as much as possible and that they still remain accessible to ‘linguistically unsophisticated readers’ (Sachs et al 1974: 734) who are familiar with the same socio-cultural context (Edwards & Potter 1992; Goodwin & Duranti 1992). Actually, often transcripts omit basic features (tempo, pitch, loudness) and can be difficult for others to understand in other ways as well, as the following example from the original article by Sacks, Schegloff and Jefferson (1974) shows: ‘I’d a’ cracked up ’f duh friggin (gla-i(h)f y’kno(h)w it) sm(h)a(h) heh heh’ (reported by Bull 2002).

In any case, the assertion that the products of qualitative analysis (ie transcripts) are understandable to participants or persons like them and the ones of quantitative analysis are not (eg a graph or a table with numerical data) remains at present an assertion of principle; it has yet to be tested empirically with whatever methods are deemed most appropriate.

In any event, even if their transcripts could do the work the qualitative analysts assume they do, such a ‘return to data’ may not be so essential. Once interaction data has been coded and their sequences have been analysed quantitatively and consistent temporal associations have been discovered, we do not necessarily need to return to the original data (eg transcripts) in order to understand the interaction process or dynamics. Sometimes it may help, other times, not. Partly it depends on how we view transcripts. For qualitative analysts transcripts are paramount and are
considered ‘data’; in our view, transcripts are primarily an important aid in observing, a ‘form of assistance’ (Bull 2002: 9).

**Two examples from the sequential analysis approach to interaction**

This section discusses two examples of possible qualitative applications of quantitative analysis of interaction, taken from the broad approach to interaction named sequential analysis. Sequential analysis is an analytic approach that views interaction as a dynamic, sequential process that unfolds in time between two or more actors who may exert reciprocal influence (Argyle 1967; Bakeman & Gottman 1997; Heyns & Lippitt 1954) and tries to grasp this dynamic character in a quantitative way.

Qualitative uses of quantitative research I: Gottman’s use of time series graphs derived from categorical data

One problem in studying interaction is taking into account different levels of analysis. Often the different levels are organised hierarchically, as for example when turns of talk are nested in different phases of interaction. Sometimes researchers have an a priori taxonomy of the phases of interaction based on the literature. However, a taxonomy of phases of interaction could also be based on empirical evidence. For example, Gottman (1979, 1983) created time-series analysis data from a stream of categorical data from marital interaction. From the categorical data he derived a new variable that was the total positive minus the total negative turns up to that point in time, separately for husbands and wives. The resulting graphs for two different couples are shown in Figure 1.

When both husband’s and wife’s graphs were negative (first graph), interaction was in a phase of negative affect reciprocation, when they were both positive (second graph), there was a phase of positive affect reciprocation and if one partner’s graph was positive and the other’s was negative the interaction was in a phase of compensation with a partner who gave in most of the time in response to the partner’s complaints. Therefore, taxonomies of couples and of phases of interaction can be classified in an inductive way. Once the phases of interaction are visualised and segmented, it is possible to come back to transcriptions and video recordings and provide a qualitative analysis of the different phases. In this example, quantitative analysis can be the basis for a subsequent qualitative analysis. For example, if we went back to transcripts, we might see that cross-complaining sequences characterise negative reciprocation in the agenda-building phase of marital interaction, as in the following extract:

W: I’m tired of spending all my time on the housework. You’re not doing your share.

H: If you used your time efficiently you wouldn’t be tired.

Once quantitative analysis is able to detect particular phases of interaction, such as positive or negative reciprocation, cross-complaining, validation or contracting sequences, then qualitative analysis can deepen our comprehension of the different phases.

Graphs from time-series, as the ones we have described, can prove useful when a researcher is looking for critical points in interaction. Critical points are when the interaction begins in a very positive/negative way and dramatically changes becoming negative/positive, respectively. In this case the slope of the graphs suddenly inverts. Therefore, quantitative analysis can prove useful to identify critical shifting points that qualitative analysis can in turn analyse.

Qualitative uses of quantitative research II: Exploring patterns of similarity in interaction sequences with program RAP

Researchers who study human interaction are usually interested in detecting temporal patterns within observed sequences of codes. A pattern is the repeated or regular way in which something
happens or is done’ (Collins COBUILD English dictionary) and it is then synonymous with order and predictability. Therefore, searching for patterns in sequences of codes that represent interaction amounts to detecting whether two or more codes often occur in succession, whether they tend to occur at the same time, or whether they tend to occur within a specific time intervals of each other. Different types of patterns can be potentially detected depending on how interac-

**Figure 1: Graphs of interactions from two couples (from Bakeman & Gottman 1997: 55)**
tion codes are represented (as event sequences, timed event sequences, etc. For a classification of types of sequential data see Bakeman & Quera 1995b). For example, the following coding scheme could be used for representing verbal interaction in a couple (\(w\) and \(h\) denote wife and husband): \(wa\) and \(ha\) (approves), \(wc\) and \(hc\) (complains), \(we\) and \(he\) (emotes), \(wp\) and \(hp\) (empathises), \(wn\) and \(hn\) (negates), \(wo\) and \(ho\) (other utterances). Each verbal turn of wife and husband is assigned one code and only the order in which the codes occur is of interest. Suppose that a couple was observed for a certain period of time and the following sequence was obtained (where every wife turn is followed by one husband turn and vice versa):

\[
we \ he \ we \ he \ we \ wa \ hp \ we \ hc \ wc \\
w \ wc \ wc \ wc \ wc \ we \ hc \ wc \ wc \ wc \ wc \ wc \\
w \ ho \ wc \ hc \ we \ wn \ wo \ wa \ wo \ ho \ wo \\
w \ ho \ wo \ ho \ we \ he \ we \ hp \ wa \ ha \ ha \\
w \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
w \ wc \ wc \ ho \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
wa \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
w \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
wa \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
w \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
w \ wc \ wc \ wc \ wc \ wc \ wc \ wc \ wc \\
\]

A classical approach to study such sequences of acts consists in tallying transitions among adjacent codes (eg wife-to-husband for all the codes), organising them in a sequential cross-tables and applying to these tables the adequate descriptive and inferential statistics that show if participants respond to their partner randomly or in systematic ways (eg husband complains after that wife complains) (Argyle 1967).

However, besides that kind of quantitative and molecular result, an exploration of the sequence as a whole can provide new insights as to whether certain patterns exist, where in the sequence they occur and even whether they tend to repeat in different but comparable sequences. Such global exploration can be carried out by first computing indices of similarity among parts of the sequence (each part defined as a window containing several consecutive codes or turns), then representing them as a two-dimensional map. Code repetitions, chains composed of certain codes occurring in succession and possible patterns consisting of codes separated by a more or less constant interval may be detected by visual inspection of that map. Moreover, the map as a whole can indicate whether the sequence is probably random or whether it contains patterns, and, if so, where they tend to be located in the sequence.

Program RAP (for RAndom Projection, Quera 2008) transforms event or timed event interaction sequences into such a map; the program represents successive windows in the sequence by a quantitative vector by means of an analytical technique called ‘random projection’ (eg Mannila & Seppänen 2001), then computes the similarity between every window and every other window. Similarity maps provided by RAP are analogous to recurrence plots, which are used by physicists, engineers and chemists, among other scientists, for depicting patterns in time series of quantitative, continuous variables (like temperature, pressure, speed and so on) and are particularly useful for discriminating among random, chaotic (ie complex) and predictable series (eg Eckmann, Kanphorst & Ruelle 1987).

Similarities, as provided by program RAP, are values ranging from 0 (no similarity between the two windows) to 1 (perfect similarity) and are displayed as grey pixels in an image, the greater the similarity the darker the pixel. Researchers can then visually inspect the image and navigate it with the mouse cursor on a computer screen in order to explore its regions; this exploration makes it possible to gain qualitative knowledge on the basis of a graphical image obtained by means of a quantitative technique.

Figure 2a shows a self-similarity map created by RAP for the previous sequence of verbal interaction; the sequence is represented twice, top to bottom and left to right, as indicated in the figure. The image was obtained by comparing every code in the sequence with every other code; when two codes are identical their similarity equals 1, otherwise it equals 0 and thus a black pixel indicates that the code in the row is identical to the
one in the column of the image. That is the simplest representation, in which every successive window contains just one code. This particular map is in fact a dot plot, a representation of sequence similarity that is mainly used in bioinformatics and text analysis for representing similarities within sequences of biomolecules and of sections of documents, respectively (eg Church & Helfman 1993). In a dot plot the main diagonal represents the similarity of every code with itself, which is obviously maximum and the image is symmetrical around the diagonal. In this example, chequered regions indicate that a particular chain of two codes repeats a number of times; specifically, the $6 \times 6$ region in the upper left corner of Figure 2a corresponds to the six first codes in the sequence, we he we he we he: dots in the first row of that region indicate that code we repeats at positions 1, 3 and 5, dots in the second row indicate that code he repeats at positions 2, 4 and 6 and so on.

Figure 2b shows a self-similarity map of that same sequence when successive windows containing not just one but three codes are applied. That is, the first three overlapped windows contain: [we he we] (sequence positions 1, 2 and 3), [he we he] (2, 3 and 4) and [we he we] (3, 4 and 5).

Pixels in that image are not just black or white; grey pixels indicate that certain windows have a non perfect similarity (eg [ha wa hp] and [ha wa ha]). Diagonal segments in the image, parallel to the main diagonal, indicate that certain chains of similar windows repeat in different parts of the sequence. For example, the lower right quarter of Figure 2b contains five diagonal black pixels close to the main diagonal; they correspond to five successive windows of the section wa ha wa hp wa ha wa hp wa ha wa in the last quarter of the sequence, which starts at position 67 and ends at position 77: window [wa ha wa] starting at 67, is repeated at 71 and 75; window [ha wa hp] starting at 68, is repeated at 72 and 74 and so on. Program RAP displays the contents of the windows when the mouse cursor is placed on the pixel that represents their similarity.

Other hints about possible patterns are vertical and horizontal lines, either continuous or fragmented, which indicate that a certain code (Figure 2a), or chain of codes (Figure 2b), occurring in a position in the sequence repeats in several other positions. For example, in Figure 2a a fragmented horizontal line composed of eight dots can be seen in the upper left quarter of the image, indicating that a certain code (hc) repeats eight times.
times forward in the sequence, specifically in section hc wc hc wc hc wc hc wc hc wc. On the other hand, horizontal or vertical white lines (i.e., regions with no dots at all) would indicate that a certain code, or chain of codes, does not repeat at other positions in the sequence; particularly, a horizontal white line as wide as the image (except for the black diagonal pixel) would show that the code, or chain of codes, corresponding to the row, is unique and never repeats.

As a whole, a similarity map reveals general features of the sequences and can be useful for classifying the interaction as patterned or random. Figure 3a shows three similarity maps (for windows containing 1, 2 and 3 codes, respectively) for a hypothetical sequence of couple interaction in which husband responds to wife at random and vice versa; Figure 3b shows three similarity maps for another hypothetical sequence containing long runs of reciprocal interactions, specifically cross-approvals (wa ha ha ...), cross-empathising (we he he he ...) and cross-complaining, (wc hc wc hc ...), which correspond to three big chequered squares along the main diagonal and indicate a development from positive to negative reciprocation. For a random sequence, black pixels in the similarity map tend to vanish rapidly as the window width increases, while for a highly patterned sequence the proportion of black pixels remains more stable.

All these kinds of graphical representations make it possible to describe bodies of data qualitatively and globally on the basis of quantitative indices of similarity or distance among portions of the data. Qualitative analysts may intervene then at two levels: when they inspect and interpret the maps, providing interactional meanings to the patterns identified (similarities, positive and negative reciprocation and compensation, and atypical sequences); and when they return to the points of the interaction identified by means of the maps and enrich their interpretations.
CONCLUSIONS

In this contribution we began by noting that traditionally qualitative analysis has served as a basic resource for quantitative studies of social interaction and then discussed some possible sources of misunderstandings between qualitative and quantitative approaches. Specifically, we discussed some concerns qualitative analysts have about quantitative research, particularly as concerns ‘natural’ units of analysis, use of ‘pre-defined’ categories, the notion of sequential context, the multifaceted aspect of interaction and, finally, the role of transcripts in observing and analysing interaction. In the next few paragraphs, we briefly provide some tentative conclusions and then comment on the proposed research applications.

In general, there are desirable features that qualitative analysts attribute to qualitative analysis and undesirable features that they claim characterise quantitative analysis. However, many of the desirable features are not necessarily a prerogative of qualitative analysis alone. Attention to participants’ point of view, natural units, grasping the sequential context and the multifaceted aspect of interaction, etc., can effectively be realised and actually are, by quantitative approaches. Likewise, some alleged undesirable features qualitative analysts attribute to quantitative research, although they may apply in individual cases, do not necessarily apply to the practice of quantitative research itself (eg the ‘pre-defined’ nature of categories, the fixity of the category systems, the disregard of context, etc.). In sum, desirable features are actually shared and undesirable features do not always apply.

Moreover, some criticised characteristics are not necessarily negative. For example, the systematic use of categories in itself or of non-participant-oriented categories is not necessarily a betrayal of reality, as some qualitative analysts seem to imply. First, non-participant-oriented category systems may be useful precisely because they represent the reality of interaction from an external point of view, focusing on aspects not necessarily perceived or expressed, verbalised or nonverbally, by participants. Second, we tend to believe that the task of social psychology, or other disciplines where social interaction is of concern, is to identify many points of view for the same reality, identifying their intersections, rather than focusing on one view while disregarding others. Third, category systems do not necessarily misrepresent reality: they may even focus our attention on aspects of the phenomenon considered crucial by careful scholars before us. This seems a crucial task not only when training observers or conceptualizing research, but also when training professional people in communication skills (Argyle 1967), such as teachers, politicians, social workers, on so on.

Based on these considerations, we tried to show with concrete examples and applications how a quantitative analysis of interaction can focus subsequent qualitative analysis. Often qualitative analysis is regarded as having a preliminary role with respect to quantitative one, but it can also be the reverse.

We have shown, for example, that the analysis of time series graphs allows us to inductively classify broad sequences of interaction or the interactions themselves between partners and how we are thereby able to grasp and identify critical points of interaction. Once quantitative analyses have identified them, qualitative analysis can further explicate them, thereby deepening our comprehension of the dynamics at stake which in turn can lead to new hypotheses and new insights.

The main application we presented regarded identifying similarities between the same (or different) sequences of interaction by means of a new program, RAP (Quera 2008). This application showed a possible way to identify orderly and predictable patterns of interactional behaviors between interactants by means of two tools: one is the summary index of similarity within the same sequence or between sequences and the other is the map. Graphical inspection of the maps resulting from quantitative analysis demonstrated a powerful tool to understand whether interactants responded to each other on a random basis or whether there are chains of similar
sequences that repeat in the same interaction. The maps can also be used in many other ways, depending on the interests of the researcher. For example, a white horizontal line would identify a unique sequence, one that does not repeat in any other position within the sequence. Therefore, inspection of similarity maps can also provide what usually is considered a privilege of qualitative analysis, the identification of unique cases.

Again, we think that a qualitative analysis can benefit from having identified similar chains in the course of the interaction, thanks to the visual inspection of the maps. From maps the analyst can easily return to the original sequences of codes and, more, to the original material (transcripts and recordings) associated with these chains and exert his/her critical capabilities on the crucial phases so identified, the better to understand the interaction at stake and/or to improve the tools with which he/she observes reality, the category systems.

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