9 CONTRIBUTIONS OF VISUALISATION

This chapter discusses visualisation as a method for research on learner interaction. Thus, the chapter responds to the fourth research question for the study, which is,

4. What are the potential contributions of visualisation as a method for research on learner interaction?

The chapter is organised into two main sections. The first section provides a discussion of the potential contributions and the limitations of visualisation as a method. A second section discusses the extent to which the visual method may be applied to additional data sets. The chapter, and the thesis, closes with some brief concluding remarks.

9.1 Contributions and Limitations of Visualisation as a Method

This section discusses the potential contributions and the limitations of visualising learner interaction. The discussion includes a sub-section on visualisation as a representation of learner interaction, a sub-section on the visual dynamical analysis presented in chapter six, a sub-section on the visual analysis of the successive dialogue-writing activities presented in chapter eight, and finally a sub-section providing a discussion of what pedagogical implications may be drawn from visualising learner interaction.

As the study has relied on a relatively small data set, the research should be interpreted as suggesting the potential of a visual approach, as illustrated by one particular application of visualisation. This means that the discussion of contributions, in the present section, should be understood as a presentation of the potential of visualisation, as illustrated by the development of the method in chapter five, as well as the outcomes of the analyses in chapters six, seven and eight.

9.1.1 Visualisation as a Representation of Learner Interaction

One of the principal motives behind the development of the visualisation was that existing methods were unable to adequately represent the dynamics of learner interaction across longer periods of time, such as the duration of a classroom activity. This influenced the formulation of the first specific research aim for the study (cf. section 1.1). This research aim suggested some form of 'global' representation of learner interaction.

The traditional representation of learner interaction, as well as other forms of spoken interaction data, is the transcript. According to Echo, in a written text, "the linear and

temporally ordered (step by step) scanning makes more difficult a global analysis of the whole text - [because] that requires an interplay of long- and short-term memory" (1990, p. 78). Moreover, Echo argues that writers can use a range of strategies to compensate for this linear manifestation of text, thereby making it easier to process the text in a global manner. However, in transcription of learner interaction there is no writer to include stylistic strategies for the benefit of a reader. Rather, a transcript represents what the learners say to each other for purposes that are very different than communicating to a potential reader of a transcript. Hence, overcoming this limitation of the transcript as a representation was an important element in responding to the first specific research aim.

The formulation of a dynamical perspective on learner interaction, in chapter three, referred to research by Fischer and Granott (1995). This research provided a precedent for visualising interaction, and an impetus for exploring visualisation as a method for representing interaction across the duration of language classroom activities. The subsequent chapters, culminating in the uses of visualisation in chapters six through eight, showed that such a visual method is feasible. Moreover, the visualisation developed in the thesis provides a global form of representation that represents learner interaction across a whole classroom activity. This constitutes a first step towards responding to the first specific research aim.

A further contribution of visualisation is that it enables different levels of representation. In the present thesis the visual method worked on two levels. One level was the global analysis of the dialogue-writing activity as a whole. Another level was the micro-contexts constituted by the writing strand, and to some extent also the attention strand. For example, patterns of attention were found in the micro-context of the composition intervals in the writing strand. Furthermore, these patterns were extracted from the global-level representation, and displayed separately (e.g., in the form of figures representing S-patterns; cf. section 6.5). In principle, the visual form of representation allows for even more detailed levels of analysis. However, in this respect the research encountered a lack of sufficient resolution in the visualisations. This limitation will be discussed below.

A final contribution of visualisation as a representation of learner interaction is that it takes advantage of the visual channel. From an information-processing perspective the advantages of visualisation appear convincing. According to Baeverstad (1989, cited in Read, 1997, p. 1) humans can process 42 million bits of data per second visually, compared to 400-800 bits per second by reading text. This difference is probably easier to make sense of when one considers the amount of space a colour picture takes on a computer hard disk, as compared to a text file giving a written description of the same picture. This advantage of visualisation is both flexible and far-reaching; it can be an effective representation for the analyst to work with, it can be used to communicate insights to colleagues, and it can be used to disseminate findings to readers of research. The visual analysis of the successive instances

of learner interaction in chapter eight is a good illustration of the latter. In that chapter, the dynamics of learner interaction in nine dialogue-writing activities were visually represented. Although the analysis in this chapter fell somewhat short of the full visual dynamical analysis employed in chapter six, it nevertheless provided a reasonably good level of insight into a substantial amount of learner interaction data in a single chapter. This is even clearer if contrasted with the in-depth analysis of the learner talk in chapter seven, which covered a single dialogue-writing activity for only one of the cases of learner interaction.

Some limitations of the visual form of representation have also emerged from the research. One limitation was hinted at in the above discussion of different levels of representation. That is, at various points in the visual dynamical analysis, in chapter six, the problem of insufficient resolution in the visualisations was raised. This is a general problem in any visualisation. Moreover, it is an issue of relevance to other methods for researching interaction. For example, conversation analysis involves working at a 'high' level of resolution, but can only sustain this for very short stretches of talk. Nevertheless, in the present research the lack of sufficient resolution was compounded by the study's reliance on general-purpose visualisation resources available in existing software packages. In particular, all the visualisation was done with MS Excel (cf. sub-section 5.2.4). Sometimes parts of the visualisations were extracted and magnified in other software packages, but also here the visualisation itself was implemented in MS Excel. The real reason for this limitation was not so much that it was impossible to represent different levels of detail in MS Excel. Rather, in practice it was too time-consuming to do so. In fact, the entire implementation of the visual method, using MS Word and MS Excel was a cumbersome procedure (cf. sections 5.2). Visualising the different activity strands and threads in a modular manner (cf. sub-section 5.2.4) compensated somewhat for the limitations of the software. However, it would be time-consuming for any other researcher to replicate the procedure. Consequently, in order to make visualisation of interaction a more manageable proposition for a wider range of applied linguistics research, specialist software for visualising interaction should be developed. Appendix K provides detailed specifications that could be used to implement such specialist software.

Another limitation of visualisation relates to the degree of correspondence between the symbols and conventions used, and the actual phenomenon of learner interaction. Although the study attempted to base the visualisation on existing conventions in related fields (cf. sub-section 5.2.2), this remains an important consideration for two reasons. First of all, since the visualisation employs a format that has little precedent, readers cannot draw on any background knowledge of similar visualisation. Furthermore, this lack of precedent, or lack of background knowledge for readers to base their interpretation, will limit the amount of useful information that can be extracted from the visualisation. In other words, the information-

processing potential of the visual channel, which was argued for above, might not be fully realised.

9.1.2   Visual Dynamical Analysis of Learner Interaction

This sub-section discusses the potential contributions of the visual dynamical analysis, as illustrated by the results presented in chapter six (cf. summary in section 6.5).

In the analysis in chapter six, the visualisations of the different activity strands and threads revealed time-ordered distributions across the timescale of the dialogue-writing activity. These time-ordered distributions were used to synthesise phases of activity in the participants' interaction. The features characterising the phases, as well as the 'strength' of the phases, varied between the participant pairs. The interaction between Veronica and Karen constitutes the clearest example of such phases. These pupils' interaction was characterised by an initial period with more task management, less sustained attention, less Norwegian spoken and more directing activity. This was followed by a longer middle period, with less task management, more sustained attention, more English spoken and less directing activity. Finally, a final period was again characterised by more task management, less sustained attention, more Norwegian spoken and more directing activity (cf. sub-section 6.2.3). This identification of phases was a first step towards visualising what was seen as the dynamics of learner interaction.

A further potential contribution of the visual dynamical analysis was the identification of temporal relationships between the activity strands and threads. That is, features of interaction sometimes appeared embedded in the micro-context of other features of the interaction (cf. section 6.1). These temporal relationships were referred to as patterns in the learner interaction. Again, the evidence for such patterns varied between the participant pairs. Examples of such patterns include the identification of different patterns of attention in the micro-context of the composition intervals observed in the writing strand. That is, S- S-plus or double-S-patterns of attention were identified in the micro-context of all the participant pairs' composition of dialogue turns (cf. summary in section 6.5). The identification of patterns was an additional step towards establishing what was seen as the dynamics of learner interaction.

Finally, the visual dynamical analysis revealed potential relationships between the patterns and phases in the participants' learner interaction. That is, the patterns in the participants' interaction sometimes appeared to change across the phases of their interaction. Also these relationships varied between the three participant pairs. For example, in the case of Veronica and Karen the patterns changed relatively clearly across phases of their learner

interaction, while in the case of Morten and Tim there was no evidence for such a relationship. Identifying potential evidence for such a relationship, between patterns and phases, was the final step towards establishing what was seen as the dynamics in the three cases of learner interaction (cf. section 6.5).

Although this identification of patterns and phases represents an interesting potential of visualisation, the small size of the present data set does not provide sufficient evidence for establishing the exact nature of these relationships. Rather, the study indicates that visualisation has the more general potential to uncover, and subsequently test out, temporal relationships between different features of learner interaction. Furthermore, the study suggests that when applied to a sufficiently large data set, and if certain patterns and/or phases can be seen to recur sufficiently often, visualisation may be able to provide insights into the nature of temporal relationships between features of learner interaction.

Any contributions of the visualisation presented in this study must also be understood in relation to the dynamical perspective developed in chapter three. One feature of this dynamical perspective is that it motivates making a close link between the categories of analysis and the classroom activity the participants are doing. In the visual analysis, the close link is clear from how some of the features of the dialogue-writing activity were used in identifying activity strands and threads, and subsequently, patterns and phases in the participants' learner interaction. For example, the composition intervals in the participants' writing of dialogue turns were used to define the writing strand (cf. sub-section 5.3.1), and this writing strand was subsequently used as a micro-context for understanding other features in the interaction (cf. sub-sections 6.2.2, 6.3.2 and 6.4.2). In other words, the potential contribution of the visual method is limited in that the outcomes of the analysis closely reflect the 'structure' of the particular dialogue-writing activity the pupils were engaged in. Even so, the analysis also identified categories that were less closely linked to the structure of the dialogue-writing activity. For example, the regulative threads were more independent of the activity the pupils were engaged in (cf. sub-section 5.3.7). As a consequence, the time-ordered distributions identified in these regulative threads may be said to be more independent of the structure provided by the dialogue-writing activity. These time-ordered distributions, therefore, may reflect the participants' own contributions to the learner interaction. Hence, whereas the contribution of the analysis may be limited by the close link it makes between some categories of analysis and the classroom activity, the analysis also suggests ways in which to explore the relationship between the structure of an activity and participants' own contributions to the resulting interaction.

A more general contribution of the visual method is that it illustrates the potential value of moving between different levels of analysis. The analysis has shown that one can explore shorter segments of interaction, while keeping in mind the interaction unfolding across the

timescale of an entire classroom activity. Moreover, the visual analysis offers a coherent way of moving between these levels of analysis. That is, the study illustrates how patterns, which represent shorter segments of interaction, may relate to phases, which represent a 'larger' organisation of interaction. This goes some way towards making the typicality and status of shorter segments of interaction more transparent, and is therefore a potential response to Long's critique that sociocultural research is characterised by the lack of "descriptive statistics pertaining to the normalcy and variation of isolated cited examples and excerpts, and the consequent unknown typicality or status of those examples" (1997, p. 320; cf. discussion in sub-section 2.3.4). The in-depth analysis of one case of learner interaction, in chapter seven, illustrated how the outcomes of the visual dynamical analysis could be used to this end. That is, the results of the visual dynamical analysis were used to guide an informed selection of episodes of learner talk for in-depth analysis. Consequently, this in-depth analysis could claim to have analysed those segments of the pupils' interaction that were most descriptive of the overall organisation, or dynamics, of these learners' interaction on the dialogue-writing activity.

The research also revealed some limitations associated with visualisation. These limitations relate to both method and theory.

One potential limitation is how the term 'phase' was used in the visual dynamical analysis. Phases were defined as periods of time with qualitatively different learner interaction (cf. sub-section 4.1). This definition implies that there is a clear transition point where the learner interaction moves from one phase to another. However, the time-ordered distributions in single activity strands and threads, used to identify the phases, sometimes described more continuous types of change across the timescale of the dialogue-writing activity. A related limitation is the use of highlighting to identify 'transition points' in the visualisations of separate activity strands and threads. That is, the visual dynamical analysis relied on dividing the visualisations into two or three parts, and highlighting these different sub-divisions effectively implied that there were identifiable transition points. The issue is further compounded by the term 'phase transition', which in complex systems theory is understood as a discontinuous, or *catastrophic* change (cf. Zeeman, 1977). However, in thinking through this limitation it is important to consider that the visual dynamical analysis *synthesised* the phases of activity from time-ordered distributions in *several separate* activity strands and threads, some of which showed continuous change, and some of which exhibited more abrupt change. That is, phases were used as an emergent outcome of several time-ordered distributions.

Another possible limitation of the visual dynamical analysis pertains to the identification of patterns of activity. Dennett has argued that "a pattern exists in some data - is real - if there is a description of the data that is more efficient than the bit map [the full data set], whether or

not anyone can concoct it" (1998, p. 103). This implies that any regularity that describes the data, whether recursive or not, can be counted as a pattern. Dennett also states that "when two individuals confront the same data, they may perceive different patterns in it, but since we can have varied interests and perspectives, these differences do not all count as disagreements" (1998, p. 103). However, the research defined a pattern as a relationship between two or more activity strands or threads in the visualisation of the learner interaction data. Furthermore, the visual dynamical analysis provided a procedure, based on this definition, for identifying patterns in the data. That is, the procedure requires the identification of potential micro-contexts in one activity strand, and then using these micro-contexts to find relationships between activity strands and threads. This ensures a certain level of rigour in the detection of patterns in the data. However, it is somewhat unclear whether this procedure counts as an algorithm, resulting in a rule-based approach, or whether it is a heuristic, providing guidelines and not rules. The present implementation of visual dynamical analysis is only a first step towards answering this question, and applications to additional data sets would be necessary to develop the analysis further.

A final limitation of the visual dynamical analysis is that it portrays the pupils' learner interaction in a 'linear' manner, along a virtual time-dimension. For example, the pupils are portrayed as writing one dialogue-turn at a time. The pupils who participated in the present research did in fact approach the dialogue-writing activity in this manner. Hence, the linear organisation of the visualisations was not necessarily inappropriate. However, there is evidence that some foreign language students approach writing activities more recursively. For example, Ting comments on her own writing of a short story in Chinese, "I proceeded in loops rather than in a linear fashion. My strategy involved a cyclical process - 'going back in order to move forward'" (1996, p. 136). Ting also comments that sometimes she would look ahead to see what see was planning to write. In the visual dynamical analysis in chapter six, the limitation is particularly evident in the visualisation of the attention strand. In this visualisation there was often more focus on content in the first half of the dialogue-writing activity, and more focus on writing in the last half of the dialogue-writing activity. This indicates that the pupils might have *planned ahead* what to write in subsequent turns of the role-play dialogue. This limitation should be explored in more depth in any further applications of the visual method.

9.1.3 Visual Analysis of Successive Instances of Learner Interaction

The visual analysis of successive instances of learner interaction in chapter eight was possibly more exploratory than the visual dynamical analysis in chapter six. That is, how changes in the pupils' activity across successive instances of learner interaction would appear in the

visualisations was uncertain (cf. discussion in sub-section 3.2.3 and section 8.1). However, this visual analysis showed that it was feasible to use the outcomes of the visual dynamical analysis of the pupils' first dialogue-writing activity to ascertain changes across the series of similar activities. Furthermore, using only the visualisations of the writing and attention strands for this analysis appeared to offer sufficient insight to make an assessment of these changes. Finally, framing the analysis in terms of the three change processes that take place in complex systems, as suggested by Pianta and Walsh (1996), offered a unique perspective on the changes in the pupils' successive instances of learner interaction. Nevertheless, the exploratory nature of this visual analysis, both in terms of theory and method, underscores the need for further research.

A more general contribution of the visual analysis in chapter eight was that it highlighted how the pupils' earlier dialogue-writing activities may have affected their later activities. This is a move away from comparing successive activities, or tasks, while giving each activity the same status in the analysis. That is, previous research usually does not incorporate an element of time into the theory that underpins comparisons of successive activities or tasks (but cf. Bygate, 1999b, who considers a *practice* effect in the analysis of learners' successive task performances). Rather, the studies are usually framed by an expectation that earlier activities will affect later activities, and discuss the extent to which these expectations were borne out in the results of the comparisons (e.g., Brooks et al., 1997; Bygate, 1996; Németh & Kormos, 2001). By contrast, in the present analysis the change processes that were identified in successive dialogue-writing activities could only be ascertained with reference to the pupils' earlier activity. In other words, the outcomes of the analysis reflected the time-ordered nature of the data set.

A final contribution of the visual analysis in chapter eight is the suggestion that change processes could be related to the pupils' focusing and directing activity. This analysis confirmed that there were dynamical relationships between the different activity strands and threads, and also provided additional evidence that the pupils' own contributions mattered in shaping the changes across the successive dialogue-writing activities. This analysis also suggests that it may be possible to combine the dynamical analysis of the present research with the methods used by previous research.

A potential limitation of the visual analysis of the successive instances of learner interaction was the long period of time that passed between each time the participants did the dialogue-writing activity (cf. section 4.5). This organisation of the data set was related to the wish for ecological validity, as well as ethical considerations. That is, the teacher was not asked to repeat the role-play task more frequently than she would otherwise do (cf. discussion in section 4.4). Nevertheless, it may be that the effects of earlier activities would have been

more clearly visible if the series of similar activities had been repeated over a shorter period of time.

A further limitation of the visual analysis in chapter eight was how the analysis 'located' change processes inside, or during, *one* of a series of successive dialogue-writing activities. Learner interaction viewed analogically *as* a complex system would be a so-called *facultative system*, i.e., a system that forms, disbands, and then forms again (Grobstein, 1973, cited in Juarrero, 1999, p. 111). Hence, a series of successive instances of learner interaction may be seen as a system forming, disbanding for a period of time, and then forming again. In such a series of facultative systems, change may either take place while the system is formed, or alternatively, there may be factors that change in the periods of time when the system is disbanded. For example, pupils' cognitive or linguistic resources may change in the interim between the successive instantiations of learner interaction. The dynamical perspective developed in chapter three went some way towards outlining the different influences on learner interaction as a complex system, including factors that could be expected to change before learner interaction took place (cf. 3.2.1). However, this was only implicitly incorporated into the analysis in chapter eight. Consequently, further research on both theory and method is necessary to develop this aspect of the visual analysis further.

9.1.4   Pedagogical Implications for Use of Classroom Activities

In order to assess the contributions and limitations of visualisation it is also useful to ask what pedagogical implications can be made from research using the visual method.

Johnson (2002) makes a distinction between applied linguistics research that explores the context-specific, or unique, and research that looks for universals. In research on learner interaction, sociocultural studies (cf. section 2.3) may be said to be exploring what is unique, in the form of in-depth studies of learner talk. By contrast, task-based studies, both from negotiation of meaning and cognitive perspectives (cf. sections 2.1 and 2.2), tend to make more universal claims. With its focus on the dynamics of learner interaction, and close link with the activity the participants are doing, the visualisation developed by this thesis may be said to be context-specific research, and exploring the unique.

Johnson also argues that in order to generalise from context-specific research, generalisations may need to be in the form of "some new entity, some new currency" (2002, p. 146). After Woods (1996), he suggests *relationships* between levels of analysis as one such new 'currency'. Moreover, Johnson suggests the identification of *processes* (as opposed to products) as another possible type of generalisation from context-specific research. The visual dynamical analysis presented in chapter six, identifies relationships between levels, and describes the dynamics of learner interaction as a process. The clearest example of

relationships between levels is the different patterns of attention in the micro-context of the composition intervals of the pupils' writing. Furthermore, it was argued that S-patterns were more fundamental in describing the participants' writing activity, as compared to S-plus-patterns and double-S-patterns (cf. section 6.5). Hence, using visual dynamical analysis on different types of classroom activities might yield other types of relationships. As for processes, the visual dynamical analysis showed that there were dynamics across the timescale of the dialogue-writing activity, dynamics in micro-contexts on shorter timescales, and that there sometimes was identifiable interaction between these different dynamics. Hence, similar dynamical relationships may be found in interaction between pupils in other settings, doing both writing and other activities. However, since the identification of the dynamics of learner interaction drew on features of the dialogue-writing activity, the exact composition of patterns and phases in interaction between participants doing other types of activities would likely be different.

In terms of pedagogical implications, the above observations imply that pupils will approach classroom activities differently. For example, the different outcomes of the visual dynamical analysis of each of the three cases of learner interaction (cf. section 6.5) shows that all the pupil-pairs made their own distinct contributions to the dialogue-writing activity. The difference was greatest between Veronica and Karen, and Morten and Tim. That is, the dynamics of learner interaction in the case of Veronica and Karen showed a great deal of change across the timescale of their first dialogue-writing activity (cf. sub-section 6.2.3). Moreover, in-depth analysis of these two pupils' interaction in chapter seven showed that they played very different roles in the activity. For example, Karen was more dominant, both in managing the activity and in deciding what content to include. Veronica, however, was more passive, both by accepting Karen's suggestions over her own, and in relying on Karen's help in writing the role-play dialogue. In contrast, the dynamics of Morten and Tim's learner interaction was comparatively stable across the timescale of their first dialogue-writing activity (cf. sub-section 6.3.3), and these two pupils seemed to have more balanced roles in the activity. However, there was no in-depth analysis of this case of learner interaction. This indicates that although the visualisation and visual analysis can be used to show the impact the pupils' contributions have in terms of patterns and phases of activity, the visual method may not be sufficient to make any strong claims about the nature of the pupils' contributions at a more detailed level. However, this observation is not an inherent limitation of visualisation. Rather, the observation reflects the level of detail that the present implementation of visualisation managed to represent.

A pedagogical implication that relates more closely to the dialogue-writing activity is that the pupils used a great deal of Norwegian. In light of other studies on interaction between language learners, this may seem somewhat surprising. However, much of the research that

was reported in the review of established perspectives, in chapter two, involved adult participants, or took place in *English as a Second Language* contexts. The present research seems to indicate that first language use may be more common in *English as a Foreign Language* contexts, such as the Norwegian primary setting of the present study.

A related pedagogical implication is what the pupils used Norwegian for. In two out of the three cases of learner interaction, the pupils spoke more Norwegian at the beginning and end of the dialogue-writing activity. Moreover, the beginning and end of the activity was also associated with a focus on task management. Hence, the pupils may have used Norwegian for managing the activity. This was in fact confirmed by the in-depth analysis of one of these two cases of learner interaction in chapter seven, where Karen's directing activity in the beginning of the dialogue-writing activity was all done in Norwegian. Another use of Norwegian was in conjunction with the patterns of attention in the micro-context of the composition intervals observed in the writing strand. In the case of Veronica and Karen, the pupils tended to speak Norwegian when they focused on content, and English when they focused on writing (cf. sub-section 6.2.2). A more general relationship between focus on content and Norwegian language use was also found in the remaining two cases of learner interaction (cf. sub-sections 6.3.2 and 6.4.2). With the possible exception of Morten and Tim (cf. discussion in section 6.5), this indicates that the dialogue-writing activity did not encourage the pupils to integrate content and foreign language use. That is, rather than generating ideational content in English, they did so in Norwegian, and subsequently translated this into English.

A final pedagogical implication is evident from the visual analysis of the series of similar dialogue-writing activities in chapter eight. This analysis again revealed that the pupils' made their own contributions to the activity. Moreover, as the activity was repeated in similar form, the pupils' contributions served to change the dynamics of their learner interaction. Finally, for each pair of participants, the successive activities were associated with different change processes. Since the main focus of this analysis was on identifying changes in activity, it is difficult to make any strong claims. However, it may be possible that as classroom activities are repeated, however similar their form, the pupils' own contributions will accumulate over time to where in the end a classroom activity will be very different than what it started out being. In the analysis in chapter eight, this was observed, to a greater or lesser extent, in all the three cases of learner interaction.

9.2   Applying the Visual Method to Additional Data Sets

This section discusses the potential for applying the visual method to additional data sets. The discussion starts with an assessment of how the data set used in the present research has affected the development of the visual method. The insights gained from this assessment

informs subsequent discussions of how activity strands and threads may be identified in additional data sets, and to what extent other data sets are suitable for visualisation.

9.2.1 The Role of the Present Data in Developing the Visual Method

A previous sub-section (cf. sub-section 9.1.2) claimed that the visual dynamical analysis made a close link between the dynamics of learner interaction, in the form of patterns and phases, and the classroom activity the participants were doing. As a consequence, the development of the visual method will have been affected by the particular activity the participants in the present research were engaged in.

The visualisation was developed using data from a dialogue-writing activity (cf. sub-section 4.4.2). The identification of some of the activity strands and threads in the present research closely mirrored this activity. For example, the basis for the writing strand was the identification of completion points in the pupils' writing of dialogue-turns. That is, since the pupils were writing a role-play dialogue, the points in time when the pupils finished writing individual dialogue-turns for their fictional characters was an identifiable feature that could be visualised (cf. sub-sections 5.3.1 and 5.3.2). To some extent, the attention strand also mirrored the activity that the participants were engaged in. In particular, focus on content and focus on writing relates directly to the dialogue-writing activity. The same may be said of some of the remaining foci of attention, such as focus on rehearsing the role-play dialogue and focus on planning the performance of the dialogue (cf. sub-section 5.3.3). Finally, some of the regulative activities, such as voicing, suggesting and helping activity (all incorporating elements of the dialogue-writing activity in their definition, cf. sub-section 5.3.7) are also examples of features that mirror the activity the participants were doing.

Other features used in the identification of the activity strands and threads were less closely linked to the dialogue-writing activity used by the research. For example, the focus on task management, a feature of the attention strand, is presumably common to all classroom activities. Moreover, several of the regulative activities were not particular to the dialogue-writing activity. That is, truncating, pacing, focusing, questioning, negotiating and directing activity are all more general in nature. Finally, the language code thread, including L1 and L2 use, also appears relevant to foreign/second language classroom activities more generally.

The extent to which the present data set has affected the development of the visual method will relate to whether the outcomes of the visual analyses were based on features mirroring the activity the participants were doing, or not. This appears to affect the procedures relating to the identification of patterns and phases, respectively, differently.

The identification of patterns of relies on the identification of activity *strands*, the features of which can 'act' as micro-contexts for understanding other features in the interaction (cf.

section 6.1). The present study relied to a great extent on the features of the writing strand acting as such a micro-context. That is, the visual analysis showed that the intervals between completion points in the writing strand (i.e., the periods of time the participants were writing individual turns in the role-play dialogue) could be used as a micro-context for understanding features on the remaining activity strands and threads. For example, the S, S-plus and double-S-patterns of attention were identified within this micro-context (cf. sub-sections 6.2.2, 6.3.2 and 6.4.2). Although the attention strand also contained features that acted as a micro-context (e.g., features in the language code thread could sometimes be understood in the micro-context of the attention strand; cf. sub-sections 6.2.2, 6.3.2 and 6.4.2), the S, S-plus and double-S-patterns of attention, in the micro-context of the writing strand, were the main outcomes of the visual dynamical analysis in chapter six. As such, the identification of these patterns will have had an important influence on the procedure developed for identifying patterns through visualisation. Moreover, since the identification of these patterns relied on the completion points of the writing strand, the procedure for identifying patterns will be closely linked to the dialogue-writing activity used by the present research.

The question, then, is whether other types of learner interaction contain features that can 'act' as micro-contexts, in the same way as the writing strand has been used in the present research. If the procedure, developed for identifying patterns of interaction in the present research, is to work on other data sets, the above question must have a positive answer.

The identification of phases in the present research relied somewhat less on features that were particular to the dialogue-writing activity the participants were engaged in. That is, the synthesis of phases often relied on time-ordered distributions in task management, as well as various regulative activities. Both of these features were less closely linked to the dialogue-writing activity the participants were engaged in (see discussion above). This also means that the development of the procedure for identifying phases in the data will have been less affected by the dialogue-writing activity used by the present research. Hence, the procedure for identifying phases may generalise more readily to other data sets.

9.2.2   Identifying Activity Strands and Threads in Additional Data Sets

The first step to visualising other data sets would be to identify activity strands and threads in this data. According to the dynamical perspective developed by the present research, the first step in this identification involves approaching data on learner interaction from several different perspectives (cf. chapter 3 and sub-section 5.2.1). In this respect, the perspectives taken in the present research (reflected in the activity strands and threads used by the study) offer a starting point. That is, depending on the type of activity under investigation, some perspectives may be preserved in full or in part, some perspectives may prove inappropriate

and can be omitted, and additional perspectives may be added. In turn, these different perspectives are the basis for the subsequent formulation of activity strands and activity threads.

The discussion of the role of the present data in the development of the visual method (cf. previous sub-section) indicates which of the perspectives identified in the present study, in the form of activity strands and threads, are more likely, and less likely, to generalise to other data sets. That is, those activity strands and threads that were closely linked to the dialogue-writing activity represent perspectives that are less likely to generalise to other data sets. For example, the writing strand, with its emphasis on writing completion points, may not generalise to other data sets. The attention strand does also, in part, mirror the dialogue-writing activity used in the present research, and is therefore also unlikely to generalise in any direct manner to other data on learner interaction. Finally, some of the regulative activities were also closely linked to the dialogue-writing activity (cf. discussion in the previous sub-section). In contrast, the task management focus in the attention strand, the language code thread, as well as some of the remaining regulative activities were less closely linked to the present data set, and might therefore generalise to other data sets.

Once a data set has been approached from a number of different perspectives, the analyst will have a 'list' of *potential* activity strands/threads. The next step is to distinguish between activity *strands* and activity *threads*. According to the procedures developed by the present research, the analyst would proceed as follows:

- visualising each of the potential activity strands/threads;
- placing the potential activity strands/threads into a hierarchy of temporal modalities (through examining combinations of visualisations);
- determining whether features of any of the potential activity strands/threads appear to 'act' as micro-contexts for understanding features on other activity strands/threads.

In turn, those potential activity strands/threads which do contain features that seem to 'act' as micro-contexts (for understanding features on other activity strands/threads) may be identified as activity *strands*. The remaining potential strands/threads can be treated as activity *threads* (cf. section 6.1).

The above procedure encounters a problem if none of the potential activity strands/threads can be seen to act as a micro-context for understanding features on other activity strands/threads. In other words, there is the possibility that a data set contains no clear activity *strands*. This potential problem is the topic of the next sub-section.

9.2.3 Suitability of Additional Data Sets for Visualisation

The single most important insight provided by the discussion of the role of the present data in the development of the visual method (cf. sub-section 9.2.1) is that there needs to be at least one (1) feature in the data that can 'act' as a micro-context for understanding other features in the interaction, in the same way as the completion points of the writing strand did in the present research (cf. sub-sections 6.2.2, 6.3.2 and 6.4.2). In other words, any new data set needs to include a feature that 'organises' the participants' interaction, just like the writing completion points seemed to 'organise' the interaction in the present research. This is a potentially important limitation in an application of the visual method to additional data sets. The extent of this limitation may be assessed by a brief survey of the type of activities, or tasks, that are common in research on learner interaction.

A common activity type in research on interaction between language learners is information-exchange tasks. That is, tasks where the participants have to exchange the information that is necessary to successfully complete the task. Depending on the exact form of such information-exchange tasks, there may, or may not, be a feature that organises the task in a way similar to the writing completion points used in the present research.

One type of information-exchange task, which is often used in language learning research, is the spot-the-difference task (e.g., Brooks & Donato, 1994; Foster, 1998; Plough & Gass, 1993; Samuda & Rounds, 1993). This task involves participants clarifying a number of differences in their respective pictures (which cannot be seen by the other interlocutor). With this kind of task, Samuda and Rounds (1993) used participants' talk about each difference in the pictures as a unit of analysis. That is, the researchers treated the discussion of each difference as a so-called 'critical episode' in the learner interaction (cf. discussion in sub-section 2.3.2). This was possible since this particular type of information-exchange task encourages a step-by-step exchange of information (one picture difference at a time). In other words, just like the intervals between writing completion points used in the present research, in a visual analysis of a spot-the-difference task, the participants' talk about each difference could be used as a micro-context for understanding other features in the interaction.

Other types of information-exchange tasks do not appear to contain any such clear organising feature. For example, making a narrative from a sequence of pictures (equally distributed between the two participants in a pair) (e.g., Skehan & Foster, 1997; Foster & Skehan, 1996; Swain & Lapkin, 2000; Pica et al., 1996), or more imaginative information-exchange tasks, such as e.g., organising a sequence of houses (Doughty & Pica, 1986), may not encourage any step-by-step exchange of information. Rather, the participants are likely to exchange information in a less predictable manner. In these cases, an analyst might find it

more difficult to find any clear feature that organises the participants activity, and an application of the visual method might be less successful.

Another common activity in research on interaction is decision-making tasks. These tasks usually require participants to prioritise a number of items in order of importance (e.g., Porter, 1986; Plough & Gass, 1993). It may be that learners approach this task as a series of decisions, with each decision assigning a rank, in the order of importance, to one item. If this were the case, it might be that each decision, in the series of decisions, organises the participants' activity. That is, the period of time associated with each decision, in the series of decisions, might serve as a micro-context for understanding other features in the interaction. However, unlike Samuda and Rounds' (1993) use of critical episodes in the case of spot-the-difference tasks, there is no precedent for treating individual decisions in decision-making tasks as units of analysis.

Other common types of activities in the language learning literature are various tasks that in some way encourage participants to focus on the grammatical forms of the target language. One such activity is the dictogloss task (cf. Wajnryb, 1990), which consists of a short text read out loud by the teacher, and subsequently reconstructed by learners working in pairs (e.g., Kowal & Swain, 1994; Storch, 1998a, 1998b, 1999; Swain & Lapkin, 2000). In applying the visual method to a dictogloss task, it may be possible to treat the participants' reconstruction of each successive sentence as a unit of analysis. This would yield completion points very similar to how the writing strand was defined in the present research. However, such an activity strand, consisting of the participants writing of individual sentences, is somewhat contrary to the unit which commonly has been used to analyse learners' interaction on this task. For example, Kowal and Swain's (1994) analysis of interaction in this task has instead made use of so-called language-related episodes (LREs). LREs are defined as talk about a problematic grammatical or lexical feature in the completion of the dictogloss.

In the review of research in chapter two, the identification of LREs was contrasted with Samuda and Rounds (1993) identification of critical episodes. That is, whereas critical episodes were argued to be closely linked to the activity the participants were doing (one critical episode for each difference discussed in the spot-the-difference task), LREs were argued to be a more abstract unit, and therefore more disconnected from the activity participants are engaged in (cf. sub-section 2.3.4). Moreover, the dynamical perspective developed in the present research, with its emphasis on making a close link between the identification of activity strands/threads and what the participants are doing (cf. sub-section 9.1.2), would, in the case of the dictogloss task, favour using the participants' writing of individual sentences as a perspective on the interaction. The outcomes of a visual analysis of the dictogloss task, using the participants' sentence writing as an activity strand, would reveal

whether such an approach is justified. LREs might still be a unit of analysis, however, but possibly in the form of a pattern identified by the visual method.

In the case of task types that do not yield any easily observable feature that organises the participants interaction, it may be possible to use Kowal and Swain's (1994) LREs, or a variation on LREs, as an activity strand, and thereby a micro-context for understanding other features of the interaction. The frequent use of different variants of LREs in the language learning literature (e.g., Storch, 1998a, 1998b, 1999; Swain, 1997; Swain & Lapkin, 1998) suggests that this might be a valid approach. However, as was argued in chapter two (cf. sub-section 2.3.4), using such a more abstract unit of analysis would result in disconnecting the categories of analysis from the participants' activity. In other words, the close link between interaction and activity, which was exploited in the development of the visual method (cf. discussion in sub-section 9.1.2), might be lost. Hence, it would constitute a departure from the dynamical perspective developed by the present research.

9.3 Concluding Remarks

In conclusion, the visual method developed in this study has responded to the research aims set out in the introduction to the thesis (cf. section 1.1). That is, in the terms of the dynamical perspective developed in chapter three, the visual dynamical analysis presented in chapter six has described the dynamics of learner interaction across the duration of the dialogue-writing activities. Moreover, the visual analysis of successive instances of learner interaction identified a range of change processes across the series of similar dialogue-writing activities. At the same time, the thesis recognises that visualisation, as a method for research on learner interaction, is a novel approach. Hence, additional research is needed to further clarify the theory, method and possible applications of visualisation.