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Detection of temporal patterns in dog–human interaction

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Abstract

A new time structure model and pattern detection procedures developed by (Magnusson, M.S., 1996. Hidden real-time patterns in intra- and inter-individual behaviour description and detection. Eur. J. Psychol. Assess. 12, 112–123; Magnusson, M.S., 2000. Discovering hidden time patterns in behaviour: T-patterns and their detection. Behav. Res. Methods, Instrum. Comput. 32, 93–110) enables us to detect complex temporal patterns in behaviour. This method has been used successfully in studying human and neuronal interactions (Anolli, L., Duncan, S. Magnusson, M.S., Riva G. (Eds.), 2005. The Hidden Structure of Interaction, IOS Press, Amsterdam). We assume that similarly to interactions between humans, cooperative and communicative interaction between dogs and humans also consist of patterns in time. We coded and analyzed a cooperative situation when the owner instructs the dog to help build a tower and complete the task. In this situation, a cooperative interaction developed spontaneously, and occurrences of hidden time patterns in behaviour can be expected. We have found such complex temporal patterns (T-patterns) in each pair during the task that cannot be detected by "standard" behaviour analysis. During cooperative interactions the dogs' and humans' behaviour becomes organized into interactive temporal patterns and that dog–human interaction is much more regular than yet has been thought. We have found that communicative behaviour units and action units can be detected in the same T-pattern during cooperative interactions. Comparing the T-patterns detected in the dog–human dyads, we have found a typical sequence emerging during the task, which was the outline of the successfully completed task. Such temporal patterns were conspicuously missing from the "randomized data" that gives additional support to the claim that interactive T-patterns do not occur by chance or arbitrarily but play a functional role during the task.

Keywords: Temporal patterns; Dog–human interaction; Cooperative interactions

1. Introduction

It has been often claimed that the ability to understand human gestural and verbal communicative signs

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allowed humans to share their social life with the dog (Miklósi et al., 2004) In everyday life man interacts with dogs through various forms of communicative and cooperative interactions that are based on the interchange of various behavioural cues, mostly in the forms of visual (e.g. Miklósi et al., 1998, 2000; Soproni et al., 2002; McKinley and Sambrook, 2000; Virányi et al., 2004) and acoustic signals, like behavioural commands and names of objects (Warden and Warner, 1928; Young, 1991; Kaminski et al., 2004; Pongrácz et al., 2001).

The interaction between humans and their dog can occur in many contexts. Most often humans walk their dog (without a leash), dogs for the blind navigate their owner (Naderi et al., 2001), or humans of various ages can be seen to play with their pet (Millot and Filiâtre, 1986; Rooney et al., 2001). The common feature for all these interactions lies in the extended duration in time, and the continuous and uninterrupted expression of behavioural sequences, much of which occur seemingly in a response to an action, displayed by the partner. Although dog–human interaction is an important part of our life, until now, the temporal structure of this interaction has received little attention. To our knowledge only three studies investigated the temporal aspects of human–dog interactions (Millot and Filiâtre, 1986; Filiâtre et al., 1986; Millot et al., 1988; Mitchell and Thompson, 1993).

These studies have focused on the synchronisation of dog and human actions, but the time window was very short taking into account only actions that have followed directly one another. Looking at the literature this corresponds to the traditional approach of temporal analysis of behaviour based on first order contingency tables ("transition matrix"), Markov chain analysis or lag sequential analysis (Fagen and Young, 1978; Bakeman and Gottman, 1997, see also McLeod, 1996). Although all these methods have their merits but they are able to detect only some aspects of the temporal structure in behaviour.

For the analysis of complex social interactions the preferred method should be highly flexible in detecting temporal patterns. However, as mathematically possible types of temporal structure and patterns are infinite, it must focus on relevant types of such structure in behaviour and interactions. To this end, Magnusson (1996, 2000) has proposed new a time structure model called T-pattern and developed special algorithms for their detection implemented in a software package called THEME (Magnusson, 2000; Anolli et al. 2005; www.hbl.hi.is; www.patternvision.com; www.noldus.com).

Looking for temporal patterns during courtship dance in humans Grammer et al. (1998) showed that synchrony could be described as a complex T-pattern time structure detected through the use of Theme. These patterns were usually very complex and highly idiosyncratic. Similarly, analysing complex cooperative behaviour in humans (football) Borrie et al. (2001) have detected a multitude of T-patterns in interactive behaviour, and showed that teams with a more patterned play structure are also perceived as "playing better" by the coach. The application of T-pattern detection also proved to be useful in analysis of the time structure of pecking behaviour in chicks, as Martaresche et al. (2000) found that feeding is composed of both synchronised and unsynchronised acts.

We assume that cooperative interactions provide a natural context for the emergence of temporal patterns. In this exploratory study, our aim was to describe temporal pattern in the behaviour of interacting dog–human dyads observed in a cooperative task. This paper was designed to study the questions: (I) whether there are any temporal patterns in the cooperative behaviour of dog–human pairs: and if yes (II) whether communicative behaviour units and action units can be detected in the same T-pattern during cooperative interactions.

2. General method

2.1. Subjects

Seven owners (3 men and 4 women) and 10 adult pet dogs (4 males and 6 females, mean age: 3.6 ± 2.7 years; 7 Belgian Tervuerens, 2 Vizslas and 1 collie) participated in the test (Table 1).

2.2. Procedure

The test was carried out in 1997 at the owners' home in a familiar room of, approximately, $3\,m \times 4\,m$. The task was to get the building blocks from a starting point to the target point with the goal of building a tower. We used 24 plastic cubic building blocks (a children's toy)