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Temporal Patterns of Co-occurrence between Children's Self-regulatory Behaviour and their Private and Social Speech

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Abstract

Temporal Patterns of Co-occurrence between Children's Self-regulatory Behaviour and their Private and Social Speech

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The role of language has been identified as crucial in the cognitive development of young children, and has been observed on different time-scales. In particular, the real-time verbal mediation of behaviour has been studied in the context of private speech use and self-regulation, pioneered by Vygotsky and continued by others who followed this line of research. However previous studies have mainly attempted to find correlations between speech and self-regulatory behaviour, but have been unable to capture the dynamic and real-time temporal interactions between these phenomena. Hence, without being able to carry out a contextual analysis of the actual instances of temporal co-occurrence between speech and behaviour, correlational analysis is limited in determining the various kinds of verbal mediation that children spontaneously employ as strategies during problem-solving and while exercising self-regulation.

The current study proposes 'temporal pattern analysis' as an effective method of extracting significantly recurring patterns of task-relevant speech and goal-directed behaviour, as they repeatedly occur in a stream of naturalistic behaviour which may also contain other temporally random events. These recurring temporal patterns are then contextually analysed, considering the pragmatic content of the speech involved and the goal-directedness of the behaviour towards a specific goal of the episode. Goal-directed episodes of behaviour in eight typically-developing preschool children were video-recorded during their self-initiated activities in the classroom as well as during a problem-solving task held in a laboratory setting. The proposed method of temporal and contextual analysis was used to examine the role of both private as well as social speech in the verbal mediation of self-regulatory behaviour during goal-attainment. A Contextual Model of Verbal Mediation was proposed in the study to account for the diverse functions that both social and private speech perform during verbal mediation of one's own and others' behaviour in a goal-directed setting, depending on the specific social and task-related context. A dynamic framework of assessment of performance was developed in the study, to account for both successful attempts at self-regulation as well as failures of self-regulation. The study also attempted to determine any consistent group differences in the styles of verbal mediation employed by the children, across the classroom and the laboratory settings.

Declaration

The following work was carried out at the Faculty of Education, University of Cambridge, during the years 2010-2017, under the supervision of Dr David Whitebread.

I hereby declare that this dissertation has not been submitted, in whole or in part, for any other degree, diploma or qualification at any other university. This dissertation is the result of my own work, and includes nothing that is the outcome of work done in collaboration. I have attempted to reference appropriately any idea or finding which is not my own.

This dissertation does not exceed the limit 80,000 words in length.

Mohini Verma

Some of the sections of this dissertation have been published as part of the following publications:

• Kuvalja, M., Basilio, M., Verma, M. and Whitebread, D. (2013). Self-directed language and private gestures in the early emergence of self-regulation: Current research issues. Hellenic Journal of Psychology, 10, 168-182.

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Chapter 1. Introduction

1.1 Overview

When a child begins to chart out a course of action to move towards her desired goal, negotiating both the physical and the social environment around her while managing her own state of emotions and motivation, a qualitatively different kind of behaviour is perceived from that when she was simply reactive to immediate external stimuli and changes in her internal states (Derryberry & Rothbart 1997), or depended on others to manage the various factors in her environment, while they facilitated her movement towards her goal. This new development in behaviour that involves the *self* in a more determining role has been termed as the psychological function of *self-regulation*. It is generally described as the ability to achieve complex goal-directed behaviour through voluntary control of one's actions, emotions and thoughts (Vohs & Baumeister 2004).

Why, one must ask, has there been such a tremendous interest in the subject of self-regulation and related concepts over the past few decades? Self-regulation in early childhood has emerged as one of the crucial factors in educational and cognitive psychology — in the school context of emergent academic skills and later academic achievement (Blair & Razza, 2007; Bull & Scerif, 2001; McClelland, Morrison & Holmes, 2000; McClelland, Cameron, Connor, Farris, Jewkes & Morrison, 2007; Normandeau & Guay, 1998; Stipek, Newton & Chudgar, 2010), and in the general context of well-adjusted social and emotional behaviour, even until much later in life (Schweinhart & Weikhart, 1997). More importantly, in the school context, training programmes for teaching self-regulated learning skills to students has been shown to have met with some success (Dignath, Buttoner & Langfeldt, 2008), being most effective at a younger age, when learning habits have not been fully formed (Hattie, Biggs & Purdie, 1996; Hendy & Whitebread, 2000). However, if one wants to inculcate or improve self-regulated learning in children, one must first look at how it normally develops in young children in the first place; which factors facilitate and mediate it, and through which mechanisms does this mediation take place.

Several factors have been put forward as facilitators and mediators of self-regulation, such as goals, self-representation, self-motivation, self-efficacy as well as a supportive social context that provides young children with the agency to regulate themselves (Pintrich, 2000). One factor that has been repeatedly identified in these studies in varying contexts is the development of language use (Luria,

1959; Vaughn, Kopp & Krakow et al., 1984; Vygotsky, 1934/1986). The proposed mechanisms through which language influences self-regulation and the time-scales on which these mechanisms operate have been varied, depending on the underlying theoretical and empirical approach of each research tradition that advances such explanations. Moreover, different aspects of language use such as verbal labelling (Luria, 1959; Müller, Zelazo, Hood, Leone & Rohrer, 2004; Müller, Zelazo, Lurye & Liebermann, 2008), expressive language abilities and vocabulary (Cole *et al.*, 2010; Vallotton & Ayoub, 2010), general language delays (Qi & Kaiser, 2004) and specific language impairments (Botting & Conti-Ramsden, 2000, Lindsay, Dockrell & Strand, 2007) have been examined while investigating the relationship between language and self-regulation.

One aspect of language use in young children that has been extensively researched in children in connection with self-regulation is *private speech* — the audible and at times partially inaudible (whispered) self-directed talk that children produce while they are engaged in any kind of activity. It is hypothesised that private speech mediates self-regulation in children as behaviour increasingly changes from other to self regulation (Vygotsky, 1934/1986). Several empirical studies have attempted to corroborate this theoretical association by finding a positive correlation between the amount of private speech produced and the degree of self-regulation required in a task indicated by its level of difficulty (Kohlberg, Yaeger & Hjertholm, 1968; Behrend, Rosengren & Perlmutter, 1989; Duncan & Pratt, 1997; Fernyhough & Fradley, 2005; Winsler, Abar, Feder, Schunn & Rubio, 2007) or measures of task performance (Azmitia, 1992; Beaudichon, 1973; Behrend et al, 1992; Goodman, 1981; Winsler, Diaz, McCarthy, Atencio & Chabay, 1999; Winsler, Diaz & Montero, 1997). In most of these studies, the underlying assumption is that a temporally dynamic and direct interaction takes place between private speech and self-regulation in young children, and that this interaction occurs necessarily in real-time, rather than over a longer time-scale or involving other intermediary factors. Hence a pertinent critique (Kuvalja, Basilio, Verma & Whitebread, 2013; Kuvalja, Verma & Whitebread, 2014) of existing research in this area is that it has mostly been restricted to correlational findings between frequencies of speech production and indirect task variables (i.e., task difficulty or task performance, which assume the deployment of self-regulation in those tasks), which present a static picture of development without the fine temporal details that may contribute towards the understanding of the mechanisms underlying these interactions on various time-scales. Hence correlational methods are inherently limited in establishing any temporal or causal relationships between private speech and self-regulation. Suggestions have been made for taking a more microanalytic approach to investigating the temporal relationship between private

speech and self-regulation. These propose the examination of the actual instances of private speech production during moments of difficulty when self-regulatory behaviour is exhibited by children (Kuvalja, Verma & Whitebread, 2014; Alderson-Day & Fernyhough, 2015).

Another area of investigation in this strand of research is the influence of other contextual factors on the interaction between self-regulatory behaviour and private speech use. These contextual factors include peer presence (Kohlberg et al., 1968; Krafft & Berk, 1998), adult presence (Berk & Garvin, 1984; Goudena, 1987; McGonigle-Chalmers, Slater & Smith, 2014) and type of activity (Krafft & Berk, 1998; Winsler, Carlton & Barry, 2000). While the effect of these contextual factors has been observed mainly on the frequency of private speech production, these studies have not explicitly investigated their effect on the qualitative aspects of the speech-behaviour relationship. Moreover, a delineation of the mechanisms by which these contextual factors influence the verbal mediation of behaviour is also needed, if these findings are to be systematically applied in educational settings.

Hence this study examines three main issues with regards to the relationship between private speech production and self-regulatory behaviour in 3-4 year-olds:

1. What can be said about the nature of temporal interaction between children's speech and self-regulatory behaviour within naturalistic goal-directed activities— are their rates of occurrence only correlated within a goal-directed activity, or do they also co-occur in real-time in a regular patterned manner? Can the specific content of the co-occurring speech and behaviour indicate real-time verbal mediation of behaviour?

2. What are the contextual features of a goal-directed activity which influence the real-time verbal mediation of behaviour, and how do they influence this mediation?

3. Are there different levels or styles of verbal mediation of behaviour which may correspond to different levels of successful self-regulation? Are there individual or group differences in these levels of verbal mediation displayed consistently across different settings?

The current study aimed to address the three above-mentioned issues using an appropriate methodology which was temporally and contextually sensitive to the dynamic temporal interactions between self-regulatory behaviour and spontaneous speech production.

1.2 Study Design

The present study investigated verbal mediation of behaviour in the context of goal-directed behaviour exhibited by 3 to 4-year-old preschool children. Eight children were directly observed in two settings — in the naturalistic context of their daily classroom activities in the preschool and during a laboratory-based 'tidy-up' task conducted in a child-observation facility. The recordings obtained from both settings were divided into smaller goal-oriented episodes, each driven by an intended goal from the perspective of the child, either easily observable or else announced by the child. Analysis was carried out for behaviour and speech produced during these episodes.

Various categories of goal-related behaviour were coded during the goal-oriented episodes. These include: *goal-directed behaviours* which identified control and monitoring strategies which were directly involved in goal-attainment; *goal-mapping behaviours* which identified various behaviours related to the beginning and termination of goal-oriented episodes; and *goal-relevant events* which identified events which might be relevant to, but not directly involved in the process of goal-attainment.

Spontaneously produced speech of the children during the goal-oriented episodes were also recorded. Speech was classified according to three independent dimensions : *directed to & adapted for* (social or private speech); *task-relevance* (task-relevant or task-irrelevant speech); and *pragmatic content* (nine context-based pragmatic categories of speech). For the purposes of this study, task-relevant social and private speech utterances, falling under any of the nine pragmatic categories were analysed.

In order to examine real-time verbal mediation of behaviour, standard correlations between speech and behaviour were coupled with co-occurrence of speech and behaviour within temporal patterns obtained through a *t-pattern search algorithm* (Magnusson, 2000). Temporally co-incident speech and behaviour events within the temporal patterns were then contextually analysed, to determine actual instances of verbal mediation of behaviour in real-time. Furthermore, for the purpose of analysing different styles of real-time verbal mediation of behaviour, the children in the study were divided into two groups, based on the frequency of unique temporal patterns detected in their observations. Temporal patterns obtained for the two groups were then contextually analysed to reveal qualitative differences in the style and level of complexity of real-time verbal mediation of behaviour.

1.3 Important contributions of the study

The focus of the present study was the development of a novel methodological approach, which was suitable for examining real-time verbal mediation of behaviour in young children. Three major contributions, in relation to the above-mentioned focus of the present study, can be highlighted here. The first contribution of the study is theoretical in nature, which sought to expand the current understanding of the functions of social and private speech, by proposing a Contextual Model of Verbal Mediation. This model proposed to assign a function to a speech utterance, in relation to verbal mediation of behaviour, based on the context in which the speech utterance is produced. Thus, the model rejected the norm of limiting certain dimensions of speech, to certain assumed functions, without investigating the actual context in which speech is produced in conjunction with behaviour.

The second contribution is the methodological approach developed in the study which went beyond correlational findings between speech and behaviour, to examine real-time significantly recurring temporal interactions between speech and behaviour through the use of t-pattern analysis. Speech and behaviour recurring within these temporal patterns were then contextually analysed to reveal actual instances of verbal mediation of behaviour in real-time. Such a methodology was also able to examine distinct styles of verbal mediation displayed by the children, some of which were more sophisticated and adaptive than others.

The third contribution of the study is educational in nature, and is related to the identification of the various qualitative aspects of verbal mediation of behaviour, which can be used by educators to identify adaptive and non-adaptive forms of verbal mediation of behaviour in the classroom. Identification of these different forms of verbal mediation can better inform and guide any strategic intervention to encourage adaptive forms of verbal mediation of behaviour for successful regulation of behaviour.

1.4 Structure of the thesis

After the **Introduction** to the study in this first chapter of the thesis, the second chapter comprises a **Literature Review** of two different strands of research that were investigated in this study, namely, *self-regulation* and *private speech*. The chapter undertakes a review of the relevant theoretical and methodological issues in the two strands of research, and finally describes how the conclusions drawn from the literature review have informed the theoretical and methodological approaches to this study.

The third chapter describes the **Methodology** adopted in the thesis. It first describes the rationale for this study, based on the literature review carried out earlier, finally leading up to its three key research aims, and the three research questions formulated to achieve these aims. The next section of the chapter discusses the methodological issues which were raised in the literature review, and how they were addressed in this study. This is followed by a detailed description of the study design, and the ethical considerations taken in the study. Finally, a description of the three types of data analysis techniques which were commonly applied to all the three research questions in the study is given, in particular the method of t-pattern analysis followed by contextual analysis of the t-patterns, employed in this study.

The next four chapters (Chapter 4-7) describe the **Results** obtained in the study. The first **General Results** chapter comprises a description of the coding framework developed for this study, followed by descriptive statistics of speech utterances and goal-related behaviours recorded in the study, in the classroom and the laboratory. A validation of the t-patterns obtained in this study, is also conducted here. The next three chapters discuss the findings obtained for each of the **three Research Questions.**

The eighth chapter of the study is a **Discussion,** which begins with a discussion of the limitations of the current study and recommendations for future research. This is followed by a summary all the findings pertaining to the general results and the three research questions. After this, the theoretical, methodological and educational significance and contributions of the findings of the study are described. Finally, a conclusion of the study is made by highlighting the significance of the main findings obtained in this study, and some concluding thoughts on the study.

Chapter 2. Literature Review

2.1 Introduction

This chapter provides an overview of certain relevant issues pertaining to the two facets of development, namely, self-regulation and language, whose temporal relationships will be examined in the current study. While each of these fields merits a detailed review of its own, a pragmatic approach has been taken here to discuss only those issues that are directly concerned with the formulation of the research questions raised in the current study, and the methodological issues of assessing and measuring the various constructs within each field, which have shaped the research design of the current study. While the first part of the review undertakes a 'Theoretical Review' of the literature on self-regulation and private speech as a particular aspect of language use, the second part of the review conducts a 'Methodological Review' of the various issues related to the assessment and measurement of self-regulation and private speech, in their respective existing literatures. After summarising the main points of the review, the chapter ends with a brief description of the ways in which the conclusions drawn from the review have been incorporated into the theoretical foundations of the current study, and have dictated the methodological approach to the design and analysis of the study.

A. Theoretical Review

2.2 Self-regulation

Humans engage in complex, goal-directed behaviour that seems more than just reflexively reacting to the immediate sensory information. This requires mechanisms to override or augment reflexive and habitual reactions in order to orchestrate behaviour according to our intentions. These mechanisms are understood to be 'cognitive' in nature and their function is to control lower-level sensory, memory and/or motor operations for a common purpose, thus representing *cognitive control* in humans (Miller, 2000). *Self-regulation* is a complex psychological function which utilises the mechanisms of cognitive control to voluntarily regulate one's actions, emotions and thoughts in accordance with one's desires and goals (Vohs & Baumeister, 2004). Thus, the observable behaviour of self-regulation can be identified as flexible, self-initiated, consciously-controlled and goal-

directed behaviour during novel or difficult situations. In situations where all of these markers are exhibited by a person, self-regulatory behaviour can be said to occur.

2.2.1 Theoretical perspectives on self-regulation

The phenomenon of self-regulation has been conceptualised and examined within various traditions of Psychology. The three seminal approaches in this regard are the sociocultural, the cognitive information-processing and the social cognitive approach. These are briefly discussed below along with some influential models of self-regulation that were inspired by these approaches.

2.2.1.1 Socio-cultural theory of self-regulation

The sociocultural theory of self-regulation was inspired by Vygotsky's theory of the development of higher mental functions through culturally-constructed artifacts (Valsiner & Van der Veer, 2000). Vygotsky differentiated between biologically-specified elementary mental functions (e.g., visual perception, attention, etc.) and voluntarily-controlled higher mental functions (e.g., voluntarily-controlled attention, memory, self-regulation of behaviour, emotions and learning, etc.) which are built upon the elementary functions through the process of *mediation* (Wertsch, 1983). *Mediation* can hence be understood as the process through which culturally-constructed artefacts (in the form of objects - paper, books, clocks, toys, etc.; concepts — self, mind, person, family, time, literacy, law, etc.; and activities — playing, producing art, reading, manufacturing, etc.) are employed to control and transform one's own and other's social and mental activity, from the elementary level to the higher level (Lantolf & Thorne, 2006). Vygotsky stated in his *genetic law of cultural development* that uniquely human higher psychological functions or "higher mental processes" in the child's ontogenetic development appeared twice, once on the social, inter-psychological plane and then on the individual, intra-psychological plane. This transfer of function from the social to the individual level and its qualitative transformation in the process, occurs through the process of mediation, as a two-component process (Karpov, 2009). Initially, the adults mediate the appropriation of cultural artefacts such as language, play, systems of counting and mnemonic techniques by the child. These tools then become internalised in the child, and in turn mediate the child's mental processes and behaviour.

Hence in this tradition, *regulation* is conceptualised as a psychological function that becomes internalised from the social (other-regulation) to the individual plane (self-regulation), through the process of *mediation* by semiotic tools and signs (Karpov, 2005). In semiotic mediation, a key

characteristic of a sign is that its function is future-oriented and necessarily differs from what it signifies in the present (Valsiner, 2001).

> "A slowly emerging understanding in my intrapsychological field 'I *can* do X' prepares me for future actions towards achieving X, rather than merely summarises my actions in the present." (Valsiner, 2001, p. 87).

Thus, signs are deemed as the makers of the immediate psychological future, and in the context of attaining a future goal, they mediate goal-directed behaviour. Hence *verbal mediation of behaviour* is one instance of semiotic mediation, wherein spoken language as a sign or tool, is employed to mediate one's high mental function of self-regulation, particularly, regulation of one's goal-directed behaviour. Thus, through the concept of verbal mediation of behaviour, the socio-cultural tradition highlights the significance of the socially acquired tool of spoken language, in the cognitive function of self-regulation of goal-directed behaviour. Hence, such a conceptualization of self-regulation, underscores the role of the *social* in the regulation of the *self.*

2.2.1.2 Cognitive theory of self-regulation

The conceptualisation of *regulation* in the cognitive tradition was oriented towards mechanisms of information-processing, and was derived from the study of control systems in the area of cybernetics (Ashby, 1947). Automatic regulation of such systems is achieved through a closed feedback loop, wherein a controlled variable (e.g., one's behaviour) is *monitored* by the system by comparing it to a pre-determined reference state (e.g., one's goal). Any discrepancy between the current state of the controlled variable and the reference state is *evaluated* as an error signal which is fed back into the system to initiate a *control* action which changes the controlled variable in order to bring it closer to the reference state. Hence the controlled variable (i.e., behaviour of an organism) is *regulated* to reach the reference state (i.e., the pre-determined goal), through the processes of *monitoring* and *control,* which work in tandem. The comparison of the current state with the reference state is carried out through the process of *evaluation,* while the initial process of setting a goal or *planning* is also considered to be a part of regulation. Hence *self-regulation* in this tradition is broadly seen as a sequence of goal-directed behaviours which comprise the processes of *planning*, *monitoring*, *control* and *evaluation* of one's actions and performance (Bronson, 2000; Whitebread et al., 2009).

Researchers inspired by the cognitive tradition have proposed several theoretical models of self-regulation. These models elaborate upon the various stages or *phases* of a task that entails self-

regulation. For example, Zimmerman and colleagues (Zimmerman, 1989; Zimmerman & Moylan, 2009) proposed three cyclical phases of self-regulation, namely, *forethought*, *performance* and *self-reflection*. The *forethought phase* broadly involved planning, goal setting and activation of self-motivating beliefs; the *performance phase* involved processes of self-control and self-observation/monitoring, and, the *self-reflection phase* involved processes of self-judgment and evaluation of the outcome.

Winne & Hadwin's (1998) 'Four-Stage Model' emphasises four phases of self-regulated learning which divides the *forethought* phase of the Zimmerman (1989) model into two distinct phases; firstly, *defining the task* based on information from the external context as well as one's cognitive conditions, followed by the *goal-setting and planning* phase. The last two phases remain similar to the previous model.

According to Pintrich (2000), the process of self-regulation consists of four stages; (1) *forethought, planning and activation*, (2) *monitoring*, (3) *control* and (4) *reaction and reflection*. Here, the *performance stage* of the last two models is divided into a *monitoring* and a *control stage*. These stages are not necessarily followed in a chronological order while performing a task, but are elements of a dynamic process, wherein, goals are changed and updated throughout the task. This may result in a different order of these processes during the task performance.

2.2.1.3 Social cognitive theory of self-regulation

The social cognitive approach was developed by Bandura (1986) to provide a more dynamic model of influence between one's behaviour, the external environment or context one is situated in, and one's personal disposition comprising cognitive, affective and biological processes. He proposed a triadic model of reciprocal causality between these three interacting factors, such that human behaviour is neither influenced solely by one's external context, nor is it determined completely by interpersonal factors. Causal agency over one's behaviour is maintained by moderating both external and internal influences. Hence self-regulation is crucial in this regard in exercising causal agency over one's thoughts, emotions and motivations and actions (Bandura, 1991). Models derived from this theoretical framework have elaborated on the various domains that the *self* regulates, such as — cognition/attention/metacognition, motivation/emotion/affect, behaviour/self and context/environment (Zimmerman, 1989; Pintrich, 2000).

Inspired by Bandura's triadic model, Zimmerman (1989) proposed triadic forms of self-regulation, wherein the three entities in Bandura's model — *person*, *behaviour* and *environment,* while interacting with each other, are also self-regulated through three self-oriented feedback loops. Hence the self-regulation of one's cognitive and affective states are combined in the form of *covert self-regulation* of the *person. Behavioural self-regulation* involves self-observation of behaviour and volitional regulation of one's efforts and performance. *Environmental self-regulation* involves the regulation of task and context conditions.

Pintrich's (2000) framework of self-regulation, on the other hand, defined four areas of regulation. While regulation of *behaviour* and *context/environment* remained similar to Zimmerman's (1989) model , the single area of *covert self-regulation* in Zimmerman's model was divided into two separate areas of regulation, namely, *cognitive processes* and *motivation/affect.*

2.2.1.4 Summary and critique

To conclude, the three traditions have different foci of inquiry and carry out separate theoretical elaborations of the phenomenon of self-regulation. The contribution of the socio-cultural theory to the research on self-regulation can be understood as bringing the 'social' to the foreground in the understanding of self-regulation, through the *mediation* of mental functions carried out by socio-cultural tools. While the socio-cultural tradition is concerned with the nature of origins of self-regulation, the cognitive information-processing tradition focuses on the processes involved during self-regulation. The social cognitive theory, on the other hand, attempts to expand the definition of self-regulation to include emotional, motivational and environmental aspects of self-regulation along with cognitive self-regulation, which seems to be the focus of the first two traditions.

However, from a developmental perspective, the models derived from these theories pose practical problems. Most of these models derive their evidence from older learners by indirect methods of data collection such as self-report questionnaires and interviews (Pintrich & de Groot, 1990; Zimmerman & Martinez-Pons, 1990; Boekaerts, Seegers & Vermeer, 1995). Hence the constructs that they measure require higher levels of reflexivity and language skills to articulate and report them accurately. In order to examine these constructs in younger children with still-developing language abilities, direct behavioural observations offer a practical solution.

However, some types of self-regulation are difficult to observe in young children for several reasons. One could argue that self-regulation of the use of one's cognitive strategies during moments of difficulty as well as the self-regulation of the emotions that accompany such moments, which have been observed in young children (Whitebread et al., 2009), represent simpler levels of control. On the other hand, intentional regulation of one's behaviour and context requires a higher level of control as well as a more sophisticated perception of the self. Hence the different domains of self-regulation do not necessarily represent a classification on the same level, such that the self-regulation of behaviour and context are at a higher level of abstraction, involving the regulation of elements which are more abstract, require greater control and agency in a situation, or take place over an extended period of time. Hence, such a hierarchical concept of self-regulation needs to be incorporated into the existing models of self-regulation, especially when observing self-regulation in a developmental framework.

The cyclical phases of planning, performance and evaluation which temporally divide a task into pre-task planning, on-task monitoring & control and post-task evaluation (Bryce & Whitebread, 2012), are more representative of higher forms of self-regulation, such as self-regulation of learning (Pintrich, 2000) and studying tasks (Winne & Hadwin, 1998) in an educational context. However, when exploring young children's self-regulatory abilities within simpler goal-directed activities, these cyclical phases of self-regulation may not be neatly discernible. A simpler model of control and monitoring processes that take place simultaneously and continuously within a goal-directed episode may be more representative of self-regulatory behaviour in young children. The model of metacognitive processing proposed by Nelson and Narens (1990) offers such a framework. This will be discussed in **Section 2.4.4** along with the measures derived from this model, under the topic of 'assessment of self-regulation'.

2.2.2 Development of self-regulation

Self-regulation has been one of the central tenets of development. However, different accounts have been proposed by researchers for charting the development of self-regulation in childhood. Although previous research contended that these skills only develop in the school years around the age of 8-10 (Veenman & Spans, 2005), more evidence for self-regulatory behaviour in younger children has been found (Whitebread, 1999). Children by the age of three have been shown to plan verbally for simple, familiar events (Hudson, Shapiro & Sosa, 1995). In a card-sorting task, Frye and colleagues (Frye, Zelazo & Palfai, 1995) have shown children at the age of 5, but not 3, to

possess the ability to switch between different sets of rules. In a review of self-regulatory abilities in children, Bronson (2000) has indicated extensive evidence for self-regulation in the motivational, emotional, prosocial and cognitive domains, throughout early childhood. In a recent large-scale study, which observed children of 3-5 years of age in naturalistic school settings, Whitebread and colleagues (2009) found various behavioural correlates of metacognition and self-regulation during learning activities that were initiated by the children. Moreover, there is new evidence suggesting the development of early self-regulatory behaviour in infants (Basilio & Rodríguez, 2011). As findings from latest research continuously lower the age at which self-regulation develops in children, a more nuanced picture of self-regulatory behaviour in children emerges. These developments will certainly support the efforts of caretakers, practitioners and researchers in helping children realise their self-regulatory potentials and provide age-appropriate scaffolding, which would further translate into helping them achieve other landmarks of development, later in life (as described in **section 2.1.4**).

2.2.3 Role of self-regulation in development

The importance of emerging self-regulatory skills in preschool is being acknowledged as a major contributor to emergent literacy and math skills in preschool (Blair & Razza, 2007; McClelland et al., 2007) as well as to later academic achievement over and above the effects of prior intellectual abilities (Normandeau & Guay, 1998; McClelland et al., 2000; Bull & Scerif, 2001; Stipek et al., 2010). Children's self-regulatory abilities have also been associated with school readiness or successful school adjustment (Ladd & Prince, 1987; Rimm-Kaufman, Pianta & Cox, 2000; Blair, 2002). Long-term effects of self-regulated learning encouraged at preschool (Schweinhart & Weikhart, 1997) have been observed on well-adjusted emotional and social behaviour in adolescence and adulthood, such that the group of at-risk preschoolers whose curriculum was based on self-regulated learning, later in life, engaged more in volunteering work, were mostly married and living with their spouses, did not generally require treatment for emotional impairment and their rate of arrest and misconduct was low compared to the group of at-risk preschoolers whose curriculum did not stress on self-regulated learning. Hence self-regulation appears to provide certain fundamental skills, not only for the specific purposes of learning in an academic set up, but also for the skills required throughout life, when challenges in different contexts confront the individual.

2.3 Language

Various measures of language use and proficiency have been associated with constructs similar to self-regulation. These include — measures of expressive and receptive language ability correlated with measures of self-regulation (Vallotton & Ayoub, 2010; Cole, 2010) and behavioural problems (Ripley & Yuill, 2005); general language delays (Qi & Kaiser, 2004) and specific language impairments (Botting & Conti-Ramsden, 2000, Lindsay, Dockrell & Strand, 2007) associated with externalising behavioural problems and poor social skills. A list of such studies investigating an association of behavioural constructs related to self-regulation, with various types of language use is tabulated in **Table 2.1**. While these language-related measures reflect overall verbal abilities and may suggest underlying mechanisms on a longer time-scale, there is a real-time component of language use that is involved in immediate verbal mediation of behaviour. Private speech, which is the type of language use with a real-time component (last category shown in **Table 2.1)**, is the focus of the current study.

The special role of private speech in mediating self-regulatory behaviour is the focus of the review below. The possible reasons for the special focus on the phenomenon of private speech amongst other aspects of language use has been mentioned. Various theoretical perspectives exploring the relationship between private speech and self-regulation have been discussed further. Finally, research carried out to chart the ontogenetic development of private speech in children and the microgenetic changes in the use of private speech across repeated trials of a task are described in the last section.

Table 2.1 List of studies which have investigated the association of self-regulatory behavioural constructs with different types of language use.

Language use	Mediated behaviour	Studies
Verbal labelling • Repetition of task instruction • Repetition of task-relevant information	• Executive function tasks	Luria, 1959; Müller, Zelazo, Hood, Leone & Rohrer, 2004; Müller, Zelazo, Lurye & Liebermann, 2008
Phonological recoding • Vocal rehearsal after presentation of auditory/visual information	• Aiding memory retrieval during a task	Al-Namlah, Fernyhough & Meins, 2006; Baddeley, Chincotta & Adlam, 2001
Linguistic/para-linguistic behaviour • Verbal behaviour during maternal interaction	• Delay gratification • Compliance with maternal instructions	Vaughn, Kopp & Krakow, 1984
Metacognitive prompts • Software-generated scaffolding prompts	• Performance in school project activities on a computer-based learning environment	Davis & Linn, 2000; Kapa, 2001; Kramarski and Gutman, 2006
Private speech • Spontaneous speech directed at oneself	• Self-regulation during problem-solving	Alarcon-Rubio, Sanchez-Medina & Prieto-Garcia; 2014; Damianova, Lucas & Sullivan, 2012; Fernyhough & Fradley, 2005; Lidstone, Meins & Fernyhough, 2010; Vygotsky, 1934/1987; Winsler *et al.*, 2003

2.3.1 Private speech

While examining the phenomenon of verbal mediation of self-regulatory behaviour, particular attention has been paid to the aspect of private speech amongst the various forms of language use mentioned above. There can be several reasons for this, such as, private speech being a peculiar feature of early language use that appears along with the development of self-regulation and disappears with age. In its developmental trajectory, private speech appears to "go underground" with age as 'inner speech' - which is hypothesised as the "voice in the head" (Baddeley, 1986), being suppressed in adults during articulatory suppression (Al-Namlah et al., 2006; Baddeley et al., 2001; Miyake, Emerson, Padilla & Ahn, 2004). Moreover, unlike language ability tests that give static measures of language use, private speech can be measured as it occurs, through direct observations of private speech utterances, measured along with the other factors being correlated with it, e.g., self-regulation. Further, think-aloud protocols used in most studies are an unnatural burden on the children when they are asked to employ it while doing their task. Private speech on the other hand is a spontaneous and natural window into the inner thoughts of the child working on the task.

2.3.2 Theoretical perspectives on private speech

This section provides a quasi-historical account of the major developments in the area of private speech research dealing with the relationship between private speech and self-regulation. Described here are the first observational accounts of private speech by Piaget, the Vygotskian socio-cultural perspective on the development and functions of private speech and some of the seminal studies by later researchers, which significantly determined the course of subsequent research in this area. Theoretical revisiting of the earlier works in this field is pertinent to the task of reformulating some of the basic concepts and methods of studying the role of private speech in mediating self-regulatory behaviour.

2.3.2.1 Piagetian perspective

The relationship between private speech and self-regulation has been conceptualised by researchers in different ways. Piaget (1923/1962) had observed the utterances of children at the age of six, in the school environment of the *Maison de Petits de l'Institut Rousseau* in Geneva, engaging in different types of self-directed talk that was not addressed to anyone else in particular. These were *repetition (echolalia), monologue* and *dual or collective monologue*. He termed them collectively as

egocentric speech, functionally different from *socialised speech.* Piaget argued that egocentric speech was a result of the child's inability to take someone else's point of view and the lack of intent to communicate, as opposed to socialised speech wherein "the child really exchanges his thoughts with others" (Piaget, 1923/1962, p.10). He also noted that the amount of egocentric speech decreased with age and disappeared after sometime, which he hypothesised as a shift towards considering the viewpoint of others, with the egocentric speech ultimately giving way to fully socialised speech.

2.3.2.2 Vygotskian perspective

Critiquing Piaget's theory regarding the function of egocentric speech in his book *Thought & Language*, Vygotsky (1934/1987) proposed instead a planning and self-regulatory role for self-directed talk, later termed as *private speech* by Flavell, Beach & Chinksy (1966). As opposed to speech moving from the egocentric to the social plane, Vygotsky suggested that private speech is originally derived from the social speech of parents and caregivers addressed to the child. According to him, social speech, which externally guides and regulates the child's behaviour through *other-regulation*, is gradually internalised and produced by the child as private speech, ultimately leading to completely unvocalised *inner speech,* which now regulates the behaviour of the child internally, thus resulting in *self-regulation.*

Vygotsky predicted that since the function of private speech involved planning and regulation, the net utterances of private speech would increase for a child in a difficult situation requiring more regulated behaviour. However, unlike the quantitative and stage-wise development suggested by Piaget, Vygotsky (1981) stressed upon a qualitative developmental change from elementary functions to higher forms of thinking. In support of this thesis, Vygotsky (1934/1987) reported that impediments placed in the normal flow of children's activities not only increased the amount of private speech, but more importantly also changed its content to become more solution-oriented. Later research supported many Vygotskian predictions and extended these findings (Kohlberg et al., 1968; Frauenglass & Diaz, 1985; Goudena, 1987; Fernyhough & Fradley, 2005). Yet it is important to note here that most of the later studies focused exclusively on the quantity of private speech emitted in different situations as opposed to the quality and semantic content of speech, emphasised by Vygotsky and others (Frawley & Lantolf, 1986; Kohlberg et al., 1968; Wertsch, 1983).

2.3.2.3 Later research

An influential article by Kohlberg and colleagues (Kohlberg *et al.*, 1968) summarised four studies that had for the first time systematically analysed the effect of sociability, presence of adults, age, IQ and task difficulty on the production of spontaneous private speech in natural and experimental settings. Apart from confirming these effects, their findings also revealed the inverted-U shaped, curvilinear trajectory of development of private speech in relation to the age of the child, with the amount of private speech increasing with age to reach a peak and then gradually declining in older children, based on their mental rather than chronological age. However, the proposed developmental hierarchy of the 7 sub-types of private speech could not be proved conclusively, especially due to the lack of evidence for a clear progression with age from *outward-directed* (remarks to non-human objects, description of one's activity) to *inward-directed*(questions answered by self, self-guiding comments) private speech (Berk, 1992; Berk & Garvin, 1984).

Influenced by Mead's view that all speech has a dialogic form and function (Kohlberg et al., 1968, p.703), Kohlberg and colleagues mainly focused on the structure and content of the private speech they observed. However, a review of private speech studies by Fuson (1979) played an influential role in shifting the focus of later research towards more quantitative aspects of private speech. Questioning the phenomenon of private speech in children as a universal stage of development, Fuson (1979) critically reviewed several studies where as many as half the samples did not utter any private speech. Since this review, many studies identified various external factors such as the type of task (semantic versus perceptual), level of difficulty (optimally difficult versus easy or very difficult), social context (collaborative versus non-collaborative adult), task-setting (classroom versus laboratory), and the level of control offered to the child by the nature of activity (open-ended, self-selected versus close-ended activity), which influenced the production of private speech in children (Berk, 1992; Berk & Landau, 1993; Frauenglass & Diaz, 1985; Fernyhough & Fradley, 2005; Goudena, 1987; Krafft & Berk, 1998; Winsler et al., 2000; Winsler & Diaz, 1995). Low frequencies of private speech observed in previous studies were thus accounted for through these factors. Hence after Fuson's (1979) review, the research designs adopted by most studies seemed to reflect a general effort to address these methodological issues and increase the amount of private speech uttered by the children they observed. This also made the various metrics of the quantity of private speech as the standard measures for studying the phenomenon of private speech.

Amongst the above studies defending low frequencies of private speech as artefacts of the then prevalent research paradigm, the first and the most influential work was carried out by Frauenglass and Diaz (1985). They showed that semantic tasks such as storytelling and picture classification, which required verbal strategies for solving them, elicited more private speech than perceptual tasks such as puzzles and block design, which could be solved using only visuo-spatial strategies. They also proposed that giving explicit instructions to children to talk during a task could increase the production of private speech in laboratory conditions. Their second conclusion was based upon a non-significant trend in the data, but it has since then been taken up by other researchers (Berk & Spuhl, 1995; Daugherty, White & Manning, 1995; Fernyhough & Fradley, 2005). Those who do not give such instructions to the children before the task (Diaz et al., 1992; Goudena, 1987; Patrick & Abravanel, 2000; Winsler, 1998) usually consider these instructions to compromise the external validity of their investigation. Such instructions may distort the spontaneous use of private speech by children when they feel like using it, and may place an artificial cognitive load on them by asking them to talk aloud while performing the task. Replication of Frauenglass & Diaz's (1985) study to show a significant increase in private speech production when accompanied by instructions to talk has not yet been carried out. However most importantly, they defended the challenge to Vygotsky's hypothesis regarding private speech and self-regulation posed by some studies that had failed to show a positive correlation between amount of private speech and task success (Beaudichon 1973; Zivin, as cited in Frauenglass & Diaz, 1985, p.358). They pointed out that as private speech occurred during difficult tasks in which children were more likely to fail, a correlation between the amount of private speech and task-failure, as seen in some studies, would be understandable and more reflective of the gradual process of self-regulation.

Coming from the tradition of investigating the dialogic aspects of private speech and its role in second-language learning, Frawley and Lantolf (1986) authored an important commentary on a study by Frauenglass and Diaz (1985). Their first criticism dealt with Frauenglass and Diaz's explanation regarding the mediating role of private speech in task performance described only in terms of the quantity of private speech. They argued that it might be the semantic content of private speech rather than its frequency, which would determine task performance. Further, they pointed out the confusion between the form, content and function of private speech with regards to the coding scheme adopted by Frauenglass and Diaz, which had been previously used by others (Fuson, 1979; Kohlberg et al., 1968). They criticised the *a priori* functional distinction assumed in the categorisation of private speech into *SR, self-reinforcing, task-irrelevant* and *whispers*, as this failed

to differentiate between the form ("whispers"), content ("task-irrelevant") and hypothetical function ("self-regulatory") of private speech. However, this typology has continued to be used in later studies (Berk, 1986; Berk & Spuhl, 1995; Fernyhough & Fradley, 2005; Winsler, 1998; Winsler et al., 2003; Winsler, Abar, Feder, Schunn & Rubio, 2007).

Their final critique related to Frauenglass and Diaz's reservations about the large individual variability seen in the production of private speech that seemed to question Vygotsky's "universal stage-like nature of private speech" (Frauenglass & Diaz, 1985, p. 364). Frawley and Lantolf assumed individual variation to be the general principle of development. Far from being problematic for statistical purposes, they suggested that individual differences should be examined in detail in naturalistic settings to understand the broad principles behind this variation before experimenting with it in laboratories. This critique still applies to contemporary studies in this area, which employ laboratory-based tasks for studying the production of private speech while overlooking qualitative variation in private speech use, both across individuals and contexts (for a notable exception looking at *quantitative* variation, see Winsler *et al.*, 2003).

2.3.3 Development of private speech

The ontogenetic pattern of development of private speech in young children was hypothesised by Vygotsky to be in the form of an inverted-U (Vygotsky, 1934/1987), showing an initial rise in overt and externalised forms of private speech utterances, reaching a peak and then declining gradually, as it is replaced by semi-internalised forms such as whispers and less intelligible mutterings, finally reaching the silent 'inner speech' stage. Evidence for such a curvilinear trajectory of development was first shown by Kohlberg and colleagues (1968) in relation to the cognitive maturity and mental age of children (4-10 years) rather than their chronological age. Different cross-sectional studies have since focused on the development trajectories of various sub-types of private speech, categorised on the basis of overtness (Winsler & Naglieri, 2003), relevance to task (Berk, 1986; Manning & White, 1990) and conjunction with task-related behaviour (Matuga, 2003).

Although an overall trend of spontaneous private speech peaking around preschool years (3-4 years) and becoming more internalised by the age of 5-6 has been observed across all these studies (Winsler, 2009), the idea of a one-to-one correspondence between a type of private speech and a fixed chronological age has not received much support (Berk, 1992). Hence in cross-sectional studies, working with different chronological age groups, it is difficult to determine the point at

which the children are on their inverted-U curve. Longitudinal studies in this case are better placed with respect to following the same children throughout their individual trajectory of development (Azmitia, 1992; Berk, 1992; Bivens & Berk, 1990; Berk & Landau, 1993; Behrend, Rosengren, & Perlmutter, 1992). The longitudinal study by Winsler and colleagues (2003) has additionally looked at the developmental course of net words per utterance, with private speech becoming more abbreviated with age, resembling inner speech characteristics, as predicted by Vygotsky (1934/1987).

An analogous transitional profile of private speech from externalised to partially internalised utterances has also been observed microgenetically on a trial-by-trial basis, as children develop competence in a single task through repeated trials (Berk & Spuhl, 1995; Duncan & Pratt, 1997).

B. Methodological Review

2.4 Assessment of self-regulation

The two major issues that arise when measuring the construct of spontaneous self-regulatory behaviour of young children in the cognitive and emotional domains in private speech research have been discussed in the sections below. Firstly, the problem with measuring self-regulation employed in a task using proxies such as task difficulty and task performance has been presented. Secondly, the ecological validity of measuring self-regulatory behaviour in children using laboratory-based set tasks is questioned. Development of naturalistic laboratory-based tasks, as well as the observation of spontaneously occurring self-regulation during children's daily activities have been suggested to address the issues discussed above. Finally those studies which directly observe children's behaviour and use measures of self-regulation based on the theoretical models of self-regulation have been reviewed, with a description of one such model, which seems most suitable for observing the behaviour of young children.

2.4.1 Proxies for measuring self-regulation

Most studies in private speech research (Berk & Spuhl, 1995; Duncan & Pratt, 1997; Fernyhough & Fradley, 2005; Winsler et al., 2007) rely on indirect measures of children's self-regulation; i.e., a certain task is given to children, and its related variables such as task performance or task difficulty are adopted as proxy measures of self-regulation rather than directly observing the moments of

difficulty when such behaviour is expressed. While the numerical values of these variables may indicate a general degree of self-regulation employed in a task, not much can be inferred about what is actually being regulated and in what manner.

2.4.1.1 Task performance

The most common measure of self-regulation in private speech studies has been the overall task performance in various set tasks. However, as first pointed out by Frauenglass & Diaz (1985), the relationship between the self-regulatory behaviour required in a task and the overall success or failure in the task is mediated by the level of difficulty of the task. Failure in a task may not necessarily indicate a lower level of self-regulation, as the task itself may be too difficult for the child to succeed in, despite using several self-regulatory strategies. On the other hand, in a very easy task that might elicit an automatic learned response, without necessarily involving any self-regulation, task success would wrongly measure the presence of self-regulatory behaviour.

Hence the Vygotskian view of private speech facilitating task performance has not been backed by decisive evidence from related research. Initial investigations did not differentiate between concurrent and future task performance, and hence showed both positive (Beaudichon, 1973; Goodman, 1981; Winsler *et al*., 1999), negative (Zivin, as cited in Frauenglass & Diaz, 1985) and no correlation (Berk, 1986; Frauenglass & Diaz, 1985) between private speech and task performance. Recent studies have identified the use of private speech as a strategy for gaining mastery over a task, which may be more associated with future success than with immediate performance. Several studies have hence reported a higher incidence of private speech as a predictor of better subsequent performance as compared to concurrent performance (Azmitia, 1992; Behrend et al., 1992; Winsler et al., 1997. For an exception to this however, see Fernyhough & Fradley, 2005).

Due to the absence of predictable trends of global correlations between amounts of private speech emitted and task performance; some researchers have started looking at speech-performance relationships on an item-by-item basis (Fernyhough & Fradley, 2005; Winsler et al., 2007). This approach considers whether private speech is accompanied by success, failure or preservative errors on each item of the task, thus looking at the context of private speech production in relation to performance. However such a method may not be useful if measures of performance and speech production need to be kept independent.

Hence it is clear that the use of task performance as a proxy for self-regulation is problematic. In tasks which are slightly above the ability of a child, a final score of performance as pass or fail might fail to detect a number of smaller achievements made in the sub-components of the task. Even with a measure that calculates performance as an aggregate of performance on the various sub-components of the task, failure in any component may not necessarily mean that the child did not apply any self-regulation strategies in achieving the goal. Hence performance scores in tandem with measures that chart out the actual self-regulatory strategies used in a task, might be able to present a better picture of a child's ability to successfully self-regulate in order to achieve a goal.

2.4.1.2 Task difficulty

As the amount of private speech produced by children has been shown to be significantly influenced by the level of difficulty of a task (Behrend et al., 1989; Duncan & Pratt, 1997; Kohlberg et al., 1968), it is important to ascertain the difficulty posed by tasks used in private speech studies on individual children. This can be determined either through pre-tests administered to the children (Berk & Spuhl, 1995) to match the task level with individual competences of the children. However, apart from being a tedious method, using a pre-test of the same task that is being used in the study can make the children accustomed to the task in the testing phase, thereby internalising the regulatory processes required for the task. Fernyhough and Fradley (2005) tried to overcome this problem by using an objective measure of task difficulty in the Tower of London task where the level of difficulty could be increased continuously without changing its perceptual complexity. This enabled a systematic comparison of the increase in the quantity of private speech with task difficulty. They found a quadratic relation between task difficulty and overall incidence of private speech with the highest levels of private speech occurring on tasks of medium difficulty. However, they failed to find any relationship between task difficulty and specific sub-types of private speech.

However, it is also inaccurate to assume that a difficult task elicits more private speech because it involves more self-regulation from a child for solving the task, when it might be the case that the task is too difficult for the child to even attempt at solving it. Hence she may talk to herself to regulate her frustration but not to regulate her cognitive behaviour in solving the task. Moreover it might even be the case that with repetitive trials, the difficult task becomes easy and hence the performance on the task becomes automated, though once it had required self-regulation of

behaviour.

Naturalistic observations of children's self-regulation (Verma, 2010; Whitebread et al., 2009b) have shown that during a single activity by the child, different types of self-regulation (cognitive, emotional or motivational) and different phases of cognitive self-regulation (planning, monitoring, error-correction or evaluation) can occur. Depending upon the requirement of the situation, these behaviours may be distributed across the activity, at different points in time. Thus, the level of difficulty of an activity may not be the same throughout a task. Instead, distinct moments of difficulty emerge which evoke different types of self-regulatory behaviour. Hence overall task performance or task difficulty as static measures are inaccurate proxies for the dynamic self-regulation required in a task.

2.4.2 Measuring self-regulation through lab-based tasks

Studies which propose to find out the role of private speech in mediating self-regulation in children should ideally measure self-regulatory behaviour directly and independent of the measures of private speech. A naturalistic setting where spontaneously produced speech accompanies the child's self-regulated behaviour would be the first choice. However in many such studies, the rationale for choosing laboratory-based tasks to measure self-regulation is that they are known to produce a large amount of private speech in children and hence assumed to involve more self-regulation (Fernyhough & Fradley, 2005; Winsler et al., 2003). The use of such a criterion for the selection of a task weakens the design of such studies since the variables, i.e., private speech and self-regulation, between which they propose to find a relationship are not independent of each other to begin with.

The commonly used tasks in private speech studies such as the Tower of London task and other model-copying tasks (Berk & Spuhl, 1995; Fernyhough & Fradley, 2005; Winsler et al., 2003) have been known to involve planning, inhibition and working memory skills (Luciana & Nelson, 1998; Welsh, Satterlee-Cartmell & Stine, 1999) whereas sorting and classification tasks such as the Wisconsin Card Sort Task, Selective Attention Task and Flexible Item Selection Task (Jacques & Zelazo, 2001; Winsler et al., 2003, 2007) measure the use of rules, selective attention and inhibitory control. However, the use of such standard tasks for measuring self-regulation betrays the underlying assumption that the phenomenon of self-regulation is synonymous with cognitive control. Models of self-regulation emphasise the comprehensive nature of self-regulation covering

emotional, social, motivational and cognitive domains (Snow, Corno & Jackson, 1996; Pintrich, 2000; Zimmerman, 1989). Laboratory based tasks that are performed by children individually, in at best a quasi-social context, only seem to examine cognitive components such as attention, planning and flexibility. Different levels of difficulty and ensuing failure or success might also involve active regulation of motivation or affect, but these features are never explicitly measured along with the standard measures of task success or failure. The absence of peers and familiar figures in the task context eliminates the natural need to regulate a social situation. Moreover such set tasks may not be able to tap into the natural self-regulating abilities of young children, due to the absence of a meaningful context of such tasks. Young children, however, have been seen to perform better when the activities they engage in are meaningful to them (Huguet, Brunot & Monteil, 2001; Istomina, 1975; Lockl & Schneider, 2002). In one of the studies, Winsler and colleagues (Winsler et al., 2003) did try to cover the different domains of self-regulation by correlating the frequency of private speech uttered during two laboratory-based tasks (Lego Construction & Selective Attention task) with goal-directed activity, sustained attention, positive affect and pro-social behaviour occurring naturally in the classroom and at home. However these correlational findings could have been further substantiated by either measuring the domain specific self-regulatory requirements of the lab-based tasks during which children's private speech was recorded, or by observing the spontaneously occurring private speech during the above-mentioned aspects of self-regulatory behaviour at home and in the classroom.

Hence the ecological validity of using standard laboratory-based tasks as being representative of children's naturally occurring self-regulation during challenging situations is highly questionable and remains to be verified, by systematically comparing it with similar observations in the naturalistic context. A compromise between the two settings can however be achieved by creating a naturalistic setting for laboratory-based tasks, which involve activities that are normally encountered by children in their daily routine. For younger participants in particular, meaningfulness of a task and its correspondence with their day-to-day experiences is crucial in presenting them with a naturalistic environment for solving the task successfully and to their best ability. Most of the standard tasks that involve multiple repeated trials can appear to be meaningless, and hence, uninteresting to even the most motivated and highly self-regulated children.

2.4.3 Measuring self-regulation through naturalistic observations

Due to the artificial nature of experimental settings and tasks, many private speech researchers have often carried out studies in classrooms (Berk, 1986; Berk & Garvin, 1983; Krafft & Berk, 1998; Winsler, Carlton & Barry, 2000; Winsler & Diaz, 1995) in order to observe naturally occurring and spontaneous private speech in children. Activities carried out in preschool and early primary classrooms, which promote independence, accountability and peer-assisted learning, have been shown to be crucial for developing self-regulatory behaviour in children (McClelland & Morrison, 2003; Normandeau & Guay, 1998; Whitebread, Bingham, Grau, Pasternak, & Sangster, 2007). Hence, observations of children's activities in the naturalistic settings provide a direct measure of self-regulation in young children (Whitebread *et al.,* 2009; Winne & Perry, 2000).

While looking at the correlation between the amount of private speech and different types of classroom activities, Krafft & Berk (1998) differentiated between *close-ended* and *open-ended* activities. They described *close-ended activity* where the goal is predetermined by the materials used in the activity, and there is only one correct solution possible for the activity, for example, puzzle-solving, story sequencing, copying a Lego® model or acting out a predetermined story. On the other hand, *open-ended activities* such as building a free form with blocks, dropping objects in different ways or make-believe play, involve the child determining the goal of the activities without necessarily having a correct or incorrect solution. Their study provided evidence for a more frequent association of private speech in children with open-ended activities, and a negative correlation with closed-ended activities. Similar results were obtained in other studies (Winsler, Carlton & Barry, 2000; Winsler & Diaz, 1995), which indicated a greater likelihood of private speech production during self-selected activities in which the children were engaged in goal-directed behaviour. The hypothetical explanation for these findings was that in such activities children constantly set new challenges for themselves within the same activity, thereby constantly requiring higher levels of self-regulation. However, more empirical data is needed regarding the specific characteristics of such activities and the discrete moments of challenge that arise in them. Since the activities that are open-ended may vary considerably in their exact content and the abilities required to carry them out, comparing behaviour across such open-ended activities can be challenging. Systematically observing behaviour in a naturalistic context involving such open-ended activities would require a system of classifying the observed behaviour into categories that capture the common features and abilities required, across all kinds of activities.

2.4.4 Measures based on models of self-regulation

Private speech studies in the Vygotskian socio-cultural tradition that work with the construct of self-regulation, rarely derive their operationalisation of self-regulation from the theoretical models developed within the cognitive and social cognitive approach (discussed in **Section 2.1;** for an exception, see Atencio & Montero, 2009). However, most of the models of self-regulation are based on evidence from older learners, and hence, are difficult to apply to the observable behaviour of younger learners (refer to **Section 2.1.1.4** for a discussion). Nelson and Narens' (1990) model of metacognitive processing in this regard provides a simple structure for observing distinct processes of *control* and *monitoring,* operating between the *object-level* and the *meta-level* (Refer to **Fig. 2.1**).
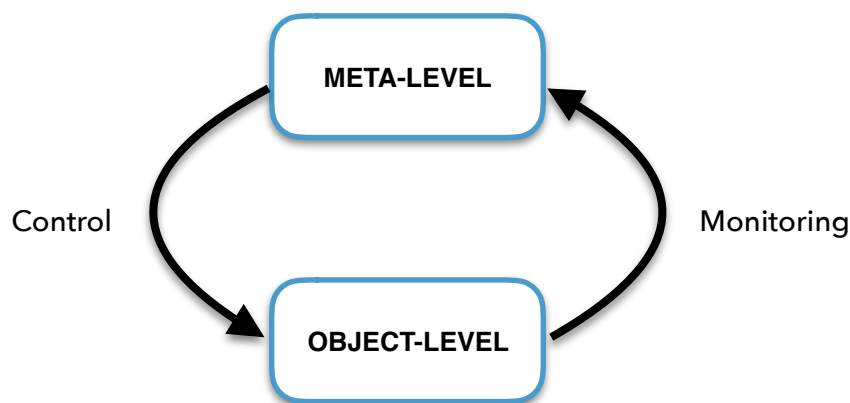
Figure 2.1 Nelson and Narens' (1990) model of metacognitive processing, depicting Control processes as the flow of information from the meta-level to the object level and Monitoring processes as the flow of information from the object-level to the meta-level, with the flow of information depicted by arrows.

The object-level is the level at which an activity takes place, and behaviour at this level is actively carried out and easily observable. The meta-level is the level which carries a mental simulation of the object-level, and where metacognitive activity directs cognitive activity. Behaviour at this level is not actively carried out, but is inferred from verbal and non-verbal behavioural cues such as exclamations, a pause in an action, a deliberate gaze, etc. The flow of information from the object-level to the meta-level constitutes *monitoring* processes, wherein, information about the object-level reaches the meta-level, in order to update its model of the object-level. The flow of information from the meta-level to the object-level constitutes *control* processes, which changes the state of the object-level or changes the object-level itself. Hence an observable action takes place during a control process, which may involve the initiation of a new strategy, continuing an ongoing strategy, terminating a strategy or changing a strategy. The change in the object-level is again reported back to the meta-level through monitoring. Thus, control and monitoring processes operate in tandem

continuously through out an activity, wherein goals are not pre-defined or fixed and may be updated and changed regularly. This dynamic model of on-task behaviour is able to capture the self-initiated behaviours of young children that may not always follow a strict temporal order of a task, as is seen in older learners. Hence, the pre-task planning phase can be subsumed under the control process, wherein new strategies are applied by initiating a new goal pursuit or collecting appropriate resources for a new activity. Further, the post-task evaluation can be subsumed under the monitoring process, since the assessment of the final outcome of task at the object-level may again inform the meta-level in order to change the object-level immediately by initiating a new goal, or update the mental simulation of the object-level for later purposes. Hence using the constructs of control and monitoring derived from the Nelson and Narens' (1990) model, researchers have measured self-regulation in young children during their open-ended free-play activities as well as closed-ended tasks (Bryce and Whitebread, 2012; Pino-Pasternak et al., 2010; Whitebread et al., 2009). While most of these studies identified *planning* and *evaluation* as separate processes of self-regulation, Bryce & Whitebread (2012) subsumed them under the processes of *control* and *monitoring*, respectively. An adapted version of the Nelson and Narens' model has been used in the current study.

2.5 Assessment of spontaneous speech

Issues that arise during the assessment and analysis of children's spontaneous speech, comprising of both private as well as social speech, are discussed in the various sub-sections below. Issues such as the system of classification for social and private speech, assessing the self-regulatory functions of social speech along with private speech, clarifying the confusion between content, form and function in the coding schemes used for classifying speech, and the analysis of individual differences in private speech use, are raised in this section.

2.5.1 Classification of social and private speech

Classification of spontaneous speech into social and private forms is usually the first step in any assessment of speech functions in the private speech literature. While the criteria used for this classification is agreed by most researchers in this field, some have argued for an additional criterion for classification, thereby making a case for expanding the definition of private speech. This will be discussed below, along with the criteria that have been commonly used so far.

The private speech literature most commonly defines private speech as that speech which is either addressed to the self or not addressed to another listener (Berk & Garvin 1984; Fernyhough & Fradley, 2005; Kraft & Berk, 1998; Winsler & Diaz, 1995) and is not explicitly used as a tool for social communication (Smolucha, 1992). Based on these definitions, other popular terms used for this phenomenon include 'self-talk' and 'self-directed speech'. This is placed in contrast to social speech, which is intended for interpersonal communication and is marked by several social cues. These definitions have been operationalised by researchers (Diaz, 1992; Furrow, 1984, 1992; Goudena, 1992; Winsler *et al.*, 1999) to distinguish between social and private speech when observing children's speech in a social context in the presence of others. The general principle is to classify speech as social if it meets certain objective paralinguistic and linguistic criteria. Those utterances which do not meet these criteria are, by default, classified as private speech (Winsler, Fernyhough, McClaren & Way, 2005). The paralinguistic behavioural criteria include eye contact, touch, pointing, gaze direction or any other intentional physical contact between the speaker and another person within 1-2 seconds of the utterance. Conversational turn-taking, questions or answers directed to another person, use of name or personal pronouns or contiguity with another social utterance within 1-2 seconds would constitute the linguistic criteria for social speech (Diaz, 1992; Feigenbaum, 1992; Furrow, 1984; 1992; Goudena, 1992). In some studies (Broner & Tarone, 2001; Winsler, 1998; Winsler *et al.*, 1999), specific characteristics of private speech such as a lowered, non-social volume of speech, change of tone, whispers or inaudible lip movements, wordplay, noises and task-directed speech after the withdrawal of the other (adult) from verbal interaction, have also been used as positive distinguishing criteria for private speech.

The early definitions of social and private speech involved categorisation on the basis of the 'intent' of speech to be for the other or the self. In order to circumvent the problem of inferring the intent of the speaker, the above-mentioned methods of differentiation, which only take explicit linguistic and paralinguistic criteria into account, were later agreed upon (Diaz, 1992). Hence social speech is now distinguished from private speech on the basis of '*addressivity*' or '*directedness*' to others and to the self respectively. Yet this solution assumes that a child possesses the conscious intent of addressing her speech to the other or the self in the first place. What if the child produces speech which appears to be addressed to another listener in a seemingly social conversation, but she fails to sufficiently adapt its contents according to the shared public knowledge between all the participants, such that it is not meaningfully apprehended by the listener. Hence such a speech can only be understood as meaningful for oneself, and ultimately serves a private purpose, irrespective of the intent or

addressivity of the speech. Such a categorisation can only be carried out if the speech utterances are not just assessed as independent units, but are instead analysed for their content and context in relation to other utterances preceding and following it (Ramirez, 1992; Smith, 2007), in order to ascertain the public or private nature of meaning that it holds for all the participants in the conversation. These adjacent utterances may be spoken by the same speaker or by another speaker. Hence, the commonly used linguistic and paralinguistic criteria miss out a certain type of private speech, which may be objectively classified as social speech, but has a private meaning for the speaker that is not adapted for the listener even during a seemingly social conversation. Hence apart form '*addressivity*' or '*directedness*' to others, an additional criterion of *'adaptability'* for others can be added to the system of classification of social and private speech. To elaborate this point further, it is important to revisit the distinctions made between social and private speech in the early literature where these demarcations have not always been so clear (Furrow, 1984; Kohlberg *et al.*, 1968; Wertsch, 1979).

Since Vygotsky, private speech has been assumed to have a social origin, while sharing the dialogic properties and other linguistic features of social speech (DiCamilla & Antón, 2004; Fernyhough, 2009; Wertsch, 1979). Kohlberg and colleagues (Kohlberg *et al.*, 1968) illustrated a particular episode of exchange between two children as an example of a type of egocentric speech classified by Piaget as "collective monologue" (Piaget, 1923/1962).

"Episode 1: Collective Monologue

BRIAN: I'm playing with this.

DAVID: A what's, a what's.

BRIAN: Oh nuts, oh nuts.

DAVID: Doodoodoo, round, round up in the sky. Do you like to ride a [toy] helicopter?

BRIAN: O.K. I want to play in the sandbox.

DAVID: Much fun. Do you want to ride the helicopter?

BRIAN: I'm going outside." (Kohlberg *et al.*, 1968, p. 693)

In this episode, the two children appeared to be in a conversation, taking turns to speak. But closer inspection shows that they were both engaged in separate monologues. While Brian described his

ongoing and future activity, there was no indication of inviting David to participate in that activity, or expecting a response from him, or responding to his earlier invitation. On the other hand, David explicitly invited Brian to "ride the helicopter", but failed to convey important information regarding what the activity really meant, which for him had a private meaning regarding an imaginary object (here, the helicopter). Kohlberg and colleagues pointed out through this example, the "parasocial" nature of certain types of private speech, when the child failed to differentiate between the self as the listener from the external listener and indulged in an external monologue in the presence of others. This parasocial quality of certain types of private speech negates the idea that children may have a clear communicative intent to direct their speech at themselves or the other. If the objective criteria were applied here for distinguishing social from private speech while ignoring the failure of the speakers to make the meaning of their utterances public, the presence of conversational turn-taking as well as personal pronouns would render such speech as social. Additional physical cues, if they had been produced in the episode, might have further supported the classification of this exchange as social speech. However in spite of the presence of these objective criteria, it can be argued that these utterances were private in nature, owing to the private meanings of the utterances spoken by both the speakers which were not shared explicitly with the external listener. This classification does not infer any intent on the part of both the children, but simply makes the decision on the basis of the content of the speech in which no meaningful and explicit social exchange of information takes place.

Such a classification has also been suggested by Girbau (1996), although it is categorised as "social speech of private meaning" (p. 511) and not analysed as a form of private speech (Girbau, 2007). DiCamilla and Antón also touched upon this issue in their analysis of collaborative speech during second language (Spanish) learning by English-speaking college students (DiCamilla & Antón, 2004). They evaluated "false dialogues" (p. 57) between dyads working together while writing compositions in Spanish, where utterances constructed as complete social conversations contained some information which was not part of mutually shared knowledge, and thus "served private means" (p.58).

Hence a strong case can be made for reconsidering the distinction between social and private speech based solely on objective cues (that determine who the speech is 'addressed to'), by including an analysis of the content and context of speech as a method of identifying private meaning (to determine who the speech is 'adapted for') in apparently social utterances, and classifying them as private speech.

2.5.2 Functionally differentiating social and private speech

As discussed above, the general principle in private speech research is to classify speech as social if it meets certain objective behavioural and linguistic criteria. Those utterances that do not meet these criteria are classified as private speech (Winsler, *et al*., 2005). However after distinguishing between these two types of speech, social speech is mostly considered as a monolithic entity and is not differentiated further, while different types of coding schemes are used to further categorise private speech. In further analyses that look for a relation between speech utterances and measures of self-regulation, social speech is mostly omitted due to the assumption that social speech has no self-regulatory function. Very few studies have chosen to categorise social speech in the same way as private speech (Feigenbaum, 1992; Furrow, 1984; Damianova, Lucas & Sullivan, 2012; Girbau, 2002). In the rationale given for these studies, these researchers have argued that the lack of any analysis of social communication in studies looking at private speech, gives an incomplete picture of the developmental trajectories and functional differences between the social and private speech. Others have even suggested the possibility of self-regulatory functions of social speech along with its communicative functions and regulation of the other achieved through overt private speech (DiCamilla & Antón, 2004; Frawley, 1997; Roebuck, 1998; Smith, 2007; Wells, 1999), thus questioning the very assumption of distinct functional differences between social and private speech.

The role of social speech can also be significant during *co-regulation* or *shared regulation* wherein children in a group regulate other's metacognitive processes unidirectionally or in a reciprocally shared manner, respectively (Iiskala, Vauras & Lehtinen, 2004; Volet, Vauras & Salonen, 2009; Whitebread *et al.*, 2007). Therefore, if verbal mediation of behaviour is to be investigated, the role of social speech cannot be ignored or assumed to be only communicative. Hence to empirically examine any functional differences between social and private speech, both need to be observed and analysed in the same manner as different manifestations of the phenomenon of spontaneous speech during naturalistic behaviour. Different areas of research in speech functions make a strong case for a more complex picture of functional differences between social and private speech. Evidence from these areas of research is presented in the sections below. Based on this evidence, a *'Contextual Model of Speech Functions'* has been proposed here, which argues for doing away with assigning *a priori* functions of self-regulation and communication to private and social speech, respectively. In its place, a more flexible and comprehensive system of assigning functions to these forms of speech is proposed, which is based on the specific context in which they are produced.

2.5.2.1 Evidence of overlapping functions of private & social speech

Ever since Vygotsky proposed a functional significance of private speech in young children, in contrast to Piaget's idea of redundant egocentricity from which they outgrow, the debate about 'why do children talk to themselves' has never ceased. Initial research in this area tried to prove Vygotsky's proposed function of private speech as self-regulatory, as opposed to communication being the defining function of social speech (Zivin, 1979). However this neatly overlapping dichotomy of private/social speech and self-regulatory/communicative function was soon questioned by other researchers who observed a dual target of private speech, one for the self and one for other nearby listeners.

Goudena (1987) observed that during a problem-solving session, children tended to produce more private speech in the presence of an adult who had been collaborative rather than non-collaborative during the instruction session earlier. He proposed an interactional interpretation of this data, wherein private speech had a dual nature, one as self-guidance during problem-solving and the other as an indirect plea for help towards the adult, who had been helpful in the previous interaction.

Furrow (1984) observed the spontaneously occurring social and private speech of 2-year-olds during free play with an experimenter, and independently coded all utterances for 12 functional uses of language. While broadly communicative uses of language, such as *regulatory* (other), *attentional* and *informative,* appeared more frequently in the speech addressed to the adult; and broadly self-directed uses of language, such as *self-regulatory*, *describing own activity* and *expressive,* appeared more frequently in the speech addressed to oneself; all of these functional uses of language nevertheless appeared in both private and social speech. Furrow suggested that strictly communicative functions of language appearing under private speech in negligible amounts could be measurement errors, while most of the self-directed functions of language still appearing substantially under social speech, in addition to private speech in young children, supported Vygotsky's hypothesis of gradual internalisation of social forms of behaviour. While the gradual mastery of self-regulation through private speech, with social speech performing transitory regulatory functions, can be accepted as a developmental phenomenon, an absolute correspondence between form (private or social speech) and function (self-regulation or communication) is hard to find even in older children, as research in other learning contexts show (DiCamilla & Antón, 2004).

Another study (McGonigle-Chalmers, Slater & Smith, 2014) questioning the solely self-regulatory nature of private speech, argues for social motives when using private speech in the presence of others, and a largely narrative rather than a self-guiding function accompanying problem-solving when using private speech in solitude. The study reported that both preschoolers and adult participants produced more private speech in the presence of a non-interactive experimenter, than in the absent condition, while engaged in a sorting task. The content of the children's private speech also comprised more task-relevant descriptions of just-completed or ongoing activity rather than planning-oriented utterances. According to McGonigle-Chalmers *et al.* (2014), the overemphasis on the self-regulatory nature of private speech, while ignoring its communicative functions, intended both for the self and for others, may offer an explanation as to why clear results of correlation between private speech use and performance measures are still lacking in the private speech literature (refer to **Section 2.3.1.1** for a discussion on private speech and task performance). Although the authors do suggest that accompanying task commentary might still be goal-related, as a means of reflecting on previous actions, or generally valuable during problem-solving.

2.5.2.2 Evidence from research in second-language learning

Gordon Wells in his work on dialogic inquiry (Wells, 2000) suggested two ways by which understanding in a dialogic exchange is enhanced. He argued that the characteristic of speech is such that it can act simultaneously as a process and a product - "as 'saying' and as 'what is said'"(Wells, 2000, p.17). The speaker, in the process of formulating speech in order to produce meaning for others, in accordance with the shared and personal meaning available in the context, also reaches a clearer understanding for himself. At the same time, once the speech has been uttered, the utterance itself acts as an external product for the speaker just as it does for the listener. By engaging with the meaning of the utterance and in preparing to respond to it as an external object, the speaker's understanding can be further improved. This dual conceptualisation of speech can also be applied to the verbal mediation of behaviour. Due to the simultaneous nature of speech as a process and a product, private speech that might be intended for the self, through the process of its formulation, can regulate one's own behaviour during problem-solving, and as a product available to nearby listeners, can also regulate others. At the same time, social speech intended as a process for guiding and correcting others can also act as a product for the speaker himself, thereby guiding and correcting his own behaviour.

A particular kind of problem-solving that highlights this simultaneous nature of speech, is the problem of learning a second language. If private speech is used for self-regulation of behaviour during problem-solving, then the use of private speech in solving the problem of learning a language might involve speech in two ways- speech as a process of 'saying' to achieve self-regulation by employing appropriate language learning strategies, and speech as a linguistic product or 'what is said', to be focused on, manipulated and expanded during language learning.

The application of sociocultural theory in second language (L2) learning (Lantolf & Pavlenko, 1995) has produced two types of studies (DiCamilla & Antón, 2004). The first type of studies examines the use of private speech/inner speech in L2 learners individually, while the second type of studies examines the occurrence of private speech in the context of L2 learners involved in collaborative language tasks. The first set of studies have highlighted the role of L2 private speech produced by language learners in gaining mastery over the language through the rehearsal of phonological, lexical and grammatical features of the L2 (McCafferty, 1994). While most of these studies focus on older children and adult language learners, one of the few studies on young L2 learners by Saville-Troike (1988) presented evidence for the use of private speech utterances in the L2 as well as L1, as a means of repeating, recalling, rehearsing and creating, substituting and expanding linguistic constructions, which later emerged in social speech use.

The second set of studies has identified private speech utterances produced in a social context during the process of solving language tasks together. It is here that the role of speech both as a process for the speaker and simultaneously as a product for the listener and the speaker becomes clearer. In a study examining the speech utterances of dyads of English-speaking college-level Spanish learners, DiCamilla and Antón (2004) identified private speech utterances embedded with the social interaction of the dyads working at text composition in Spanish. While they support the categorisation of such utterances as private, or directed at the speaker, on the basis of their linguistic and paralinguistic features, they also agree with previous researchers (Donato, 2000; Roebuck, 1998; Wells, 1999) that the distinction between social and private speech in an interactive context is difficult to make, since "all overt speech uttered in a context of social interaction is necessarily speech available to both speaker and hearer(s)" (Wells, 1999, p. 251).

In another study of primary school-aged bilingual English learners working in small groups (Smith, 2007), private speech utterances in English were identified during an interactive board game designed to develop language learning. Based on the various instances of private speech embedded

within an arguably interactive context of a board game, Smith (2007) proposed a mutually interactive relationship between social and private speech, performing social and cognitive functions for intermental activity as well as cognitive functions for intramental activity, at times simultaneously. Hence speech produced primarily for oneself, once spoken aloud in a social context, and functioning as speech as a product, "has the potential to be perceived as an intermental act, even if one's intention is primarily private" (Smith, 2007, p.354). At the same time, even clearly social speech produced in response to others, by virtue of characterising speech as a process, "can result in an instantiation of intramental activity" (p.354).

2.5.2.3 Contextual Model of Verbal Mediation

After having reviewed the various studies in the private speech literature, which point at different functions of private (and social) speech in different contexts, a strong case can be made for doing away with the functional dichotomy of private and social speech as solely self-regulatory and communicative, respectively. In its place, a more context-dependent model of verbal mediation of behaviour is being proposed here (**Fig. 2.2**), which takes into account the dual nature of speech as a *process* and a *product*, and hence allows both private and social speech to have an effect on the self as well as on others, by acting directly as a process and indirectly as a product.

As discussed earlier in **Section 2.2.1.1,** the socio-cultural understanding of *verbal mediation of behaviour* is the process through which speech as a cultural and psychological tool is employed to control and transform one's own and other's social and cognitive activity, in order to attain a desired goal. Based on this definition, which involves mediation of one's own as well as others' behaviour, speech can have both a regulatory/cognitive as well as a communicative/social function, for oneself and for others. The model proposed below outlines the various ways in which these functions may be achieved for the self and for others, through both private and social speech, depending upon the context in which such a function is actualised.

Contextual Model of Verbal Mediation

Figure 2.2 Pictorial depiction of the *Contextual Model of Verbal Mediation*, showing the eight possible speech profiles (A-H) - combinations of *form of speech,* (private or social speech), *timing of speech* (preceding or following), *site of action of speech* (self or other) and *means of action* (process or product).

Forms of speech

In this model, social and private speech are seen as identifiably different *forms of speech*, wherein social speech is directed at and adapted to the listener while private speech is not directed at or adapted to a listener in particular. While the functional distinction between private and social speech might be difficult to make, researchers whose studies have been reviewed above still concur that the two forms of speech are clearly distinguishable on the basis of linguistic, paralinguistic and contextual analyses of the speech utterances.

Sites and means of action

In the model, the *self* and the *other* are not necessarily the entities to whom the speech utterance is addressed, but rather, they refer to the *site of action* upon which the utterance has an effect vis-à-vis its function. The speech utterance can act on these sites through two *means of action* either as a *process* - wherein the function of the utterance is achieved through the 'act of saying', or as a *product* - wherein the function of the utterance is achieved through the appropriation of the meaning of 'what is said'. Hence, private speech may have an effect on the self through the *process* of speaking, and even simultaneously, it may have an effect on others, by acting as a *product* of speech. Similarly, social speech may affect others through the process of speaking, while the content or product of the speech itself may also influence the self.

Timing of speech

These effects can take place through two types of temporal relation between speech and the mediated behaviour. The first type of speech precedes mediated behaviour in time and may be classified as *preceding*. In this type of temporal relation with behaviour, speech may be involved in various functions such as planning the subsequent mediated behaviour, directing others towards subsequent behaviour, announcing upcoming behaviour, etc. The actual function of such speech may depend upon the specific context in which it is used for oneself or for others, or both. Such type of speech may be compared to the 'control processes' in the Nelson and Narens' model (1990, refer to **Section 2.4.4** for a description of the model) which are defined as the flow of information from the meta-level (e.g., metacognitive representation of the task) to the object-level (e.g., task-relevant behaviour). Hence speech which precedes task-relevant behaviour at the object-level may carry information from the meta-level, and therefore change the state of the object-level, by mediating the task-relevant behaviour at the object-level. The second type of speech follows just-

completed or ongoing relevant behaviour in time, and may be classified as *following*. In such a temporal relation with behaviour, speech may be involved in functions such as providing a commentary of the just-completed relevant behaviour, reporting the conclusions arrived at by the previous monitoring behaviour, evaluating the efficacy of the previous behaviour, focusing on the ongoing behaviour, etc. Such types of speech may be compared to the 'monitoring processes' in the Nelson and Narens' model (1990) which are defined as the flow of information from the object-level (task-relevant behaviour) to the metal-level (metacognitive representation of the task). Hence speech which follows task-relevant behaviour at the object-level may carry information about the current state of the object-level to the meta-level, and hence monitor and report any changes made at the object-level. In the situations where speech follows a particular behavior, the relevant behaviour is not the behaviour being directly transformed or mediated. However, reporting on the relevant behaviour through speech results in verbalising the information relevant to the behaviour in question, which in turn may be employed for mediating subsequent behaviour. This cycle can be compared to the cyclical flow of information between the meta and objects-levels in the Nelson and Narens' model (1990). Thus, based on the *timing of speech* with respect to relevant behaviour, speech may be classified as *preceding* or *following*.

Hence, the combinations of the two *forms of speech* and *timing of speech,* with the two *sites of action of speech* and the *means of action of speech* by which they produce an effect at any site of action, result in eight different speech profiles, (depicted in the model by the alphabets **A** to **H**, **Fig. 2.2**). These speech profiles represent the various ways in which verbal mediation of one's own and others' behaviour takes place. The presence of these speech profiles can be determined by examining the features of a particular context in which the speech is produced. These contextual features would hence include - who the speech is directed at and adapted to (social or private), when is the speech produced in relation to the relevant behaviour (preceding or following behaviour), who does it have an effect on (self or other) and how this effect is produced (as a process or as a product). Thus, it may be possible that the same speech utterance is categorised as two different speech profiles, based on the different means by which the same utterance has a simultaneous effect on the self and the other. This would necessarily require observing the effect of the speech utterance on the behaviour of the self or others, rather than assuming such an effect simply based on the content of the speech.

Hence the actual function of speech during verbal mediation of behaviour may be derived from this model by determining the profile of the speech based on its context of production, as well as the

specific content of the speech and behaviour involved in an activity or task. Contextual speech functions, thus derived, would be independent from attributing any *a priori* function to the form of speech (e.g., communicative and regulatory function for *social* and *private* speech, respectively; refer to **Section 2.5.3.4** on the confusion between form and function of speech), timing of speech (guiding and concluding function for *preceding* and *following* speech, respectively; refer to **Section 2.5.5** on attributing function based on temporal order of speech), and site of action of speech (private and social for speech acting on *self* and *other,* respectively).

2.5.2.4 Verbal mediation of behaviour for self and others

Two scenarios of verbal mediation of behaviour can be derived from the Contextual Model described above. As mentioned in the previous section, the process of *verbal mediation of behaviour* can bring about the transformation of one's own as well as others' social and cognitive activity. Hence, speech may be used for the *control* and *monitoring* of one's own behaviour through speech *preceding* and *following* the mediated behaviour, respectively, as seen in instances of verbal self-regulation of behaviour. Speech may similarly be used for mediating others' behaviour as seen during social modes of regulation in a collaborative situation, such as *co-regulation* or *shared regulation.* However, as per the basic premise of the Contextual Model, both private and social speech may be involved during self-regulation, directly (through the process of speaking) and indirectly (as a product of speech), respectively. Similarly, both social and private speech may be involved during *other-regulation* (involving co-regulation or shared regulation), directly and indirectly, respectively. Hence two models can be derived from the Contextual Model of Verbal Mediation to observe verbally-mediated self and other regulation separately. These are the models for *verbal mediation of own behaviour* and *verbal mediation of others' behaviour,* presented in **Fig. 2.3** and **Fig. 2.4** respectively.

Verbal mediation of own behaviour

Figure 2.3 Pictorial depiction of *verbal mediation of own behaviour* derived from the Contextual Model, showing the four possible speech profiles (A,B,G & H) - combinations of *form of speech,* (private or social speech), *timing of speech* (preceding or following) and *means of action* (process or product), all influencing the 'self' as the **site of action of speech**

Verbal mediation of others' behaviour
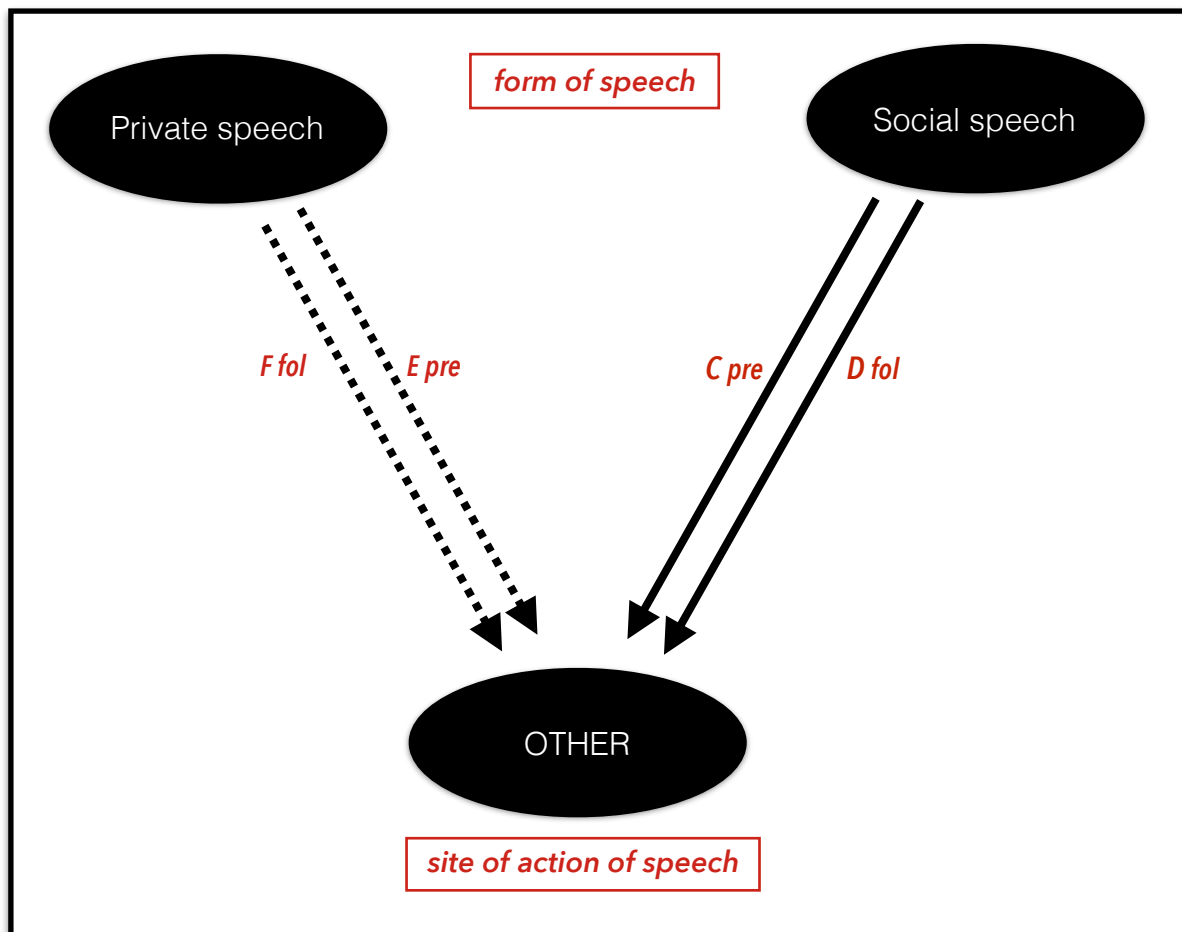
speech profile types:
C-**social_guiding_other_process**
D-**social_following_other_process**
E-**private_guiding_other_product**
F-**private_following_other_product**

means of action

―――― process

•••••••• product

timing of speech

pre: preceding

fol: following

Figure 2.4 Pictorial depiction of *verbal mediation of others' behaviour* derived from the Contextual Model, showing the four possible speech profiles (C, D, E & F) - combinations of *form of speech,* (private or social speech), *timing of speech* (preceding or following) and *means of action* (process or product), all influencing the 'other' as the **site of action of speech**

2.5.2.5 Correspondence between Contextual Model and previous studies

All of the eight speech profiles (A-H, **Fig. 2.2**) combining form, timing, site of action and means of action seem to correspond to the varied instances of speech and behaviour which have been reported in the studies reviewed above in **Section 2.4.2.1** and **Section 2.4.2.2**. The ways in which the examples from these studies correspond to one of the eight profiles are described below. Their correspondence is concisely tabulated further according to each speech profile, in **Table 2.2** given further below.

In the study by Furrow (1984), utterances produced by 2-year-old children playing with an adult were recorded (refer to **Section 2.4.2.1** for more details of the study). These utterances were coded as *social* or *private* based on the social context in which they were spoken and were also categorised into 12 functional uses of language, independently from the social context. Some of the most common utterances produced by the children were reported as social speech performing *regulatory* (other), *attentional* and *informative* functions; and private speech performing *self-regulatory*, *describing own activity* and *expressive* functions (refer to **Table 2.2** for definitions of each of the functional categories described in the study which correspond to one of the eight speech profiles). The social speech utterances accompanying the '*regulatory*' function can be matched with the **Type C** speech profile (social_preceding_other_process) of the model, while social speech with '*attentional*' and '*informative*' functions seem to correspond to the **Type D** speech profile (social_following_other_process). The private speech utterances with '*self-regulatory*' function in the study, can be represented by the **Type A** speech profile (private_preceding_self_process) while private speech with '*describing own activity*' and '*expressive*' functions can be matched with the **Type B** speech profile (private_following_self_process). However, Furrow (1984) also reported a considerable percentage of social speech utterances performing the functions which had most frequently appeared with private speech, namely, '*self-regulatory*', '*describing own activity*' and '*expressive*' functions. Hence social speech utterances by two-year-olds directed at the experimenter but fulfilling the '*self-regulatory*' function can be represented by the **Type G** (social_preceding _self _product), while social speech with '*describing own activity*' and '*expressive*' functions can be matched with the **Type H** speech profile (social_following_self_product).

The study by Goudena (1987) examined the frequency and possible function of private and social speech during two types of non-interacting adult presence during a problem-solving session — an adult who had been collaborative in the earlier training session, and an adult who had been non-

collaborative during the training session (refer to **Section 2.4.2.1** for more details of the study). The four most frequent speech utterances spoken by the children in the presence of a collaborative adult were *task-relevant*, *directed at the task* (not directed at one's own performance), and involved *self-guiding* speech content which dealt with the regulation of the non-verbal puzzle act. Those self-guiding utterances which began before the beginning of the non-verbal act were termed as '*planning*', while those which accompanied the non-verbal act were called '*concomitant*', and those which began after the completion of the act were called '*concluding*', in the study. Out of the four frequent speech types, three of them were private, while one of them was social speech. In the context of the presence of an adult who had been collaborative in an earlier training task, but was not interacting during the problem-solving session, these utterances were interpreted by Goudena as an indirect plea for help, or informing the adult about the task difficulty, perhaps during an event of personal failure. The amount of private speech utterances did not covary with quality of task performance in the study. Hence, Goudena did not consider them to be involved in self-guidance, meant for the self. While the social speech utterance could be understood as directly meant for the adult, through the *process* of speaking, the private speech utterances could be understood as indirectly meant for the adult, as the *product* of speech. Hence, from the eight types of speech profiles proposed in the model, the private speech utterances meant for others which were labeled as '*planning*' (P25) seem to correspond to the **Type E** (private_preceding_other_product) speech profile. Those private speech utterances which were labeled as '*concluding*' (P29) and '*concomitant*' (P27) in the study, seem to correspond to the **Type F** speech profile (private_communicative_other_product), as shown in **Table 2.2**. The utterances which were labeled as 'concomitant' by Goudena (1987) have been classified as 'following' based on the *timing of speech* in the Contextual Model, since it was defined as speech that occurs after just-completed or during ongoing behaviour. The social speech utterances which were labeled '*concluding*' (P13) seem to correspond to the **Type D** speech profile (social_following_other_process).

The study by McGonigle-Chalmers *et al.* (2014) reported several private speech utterances produced by preschoolers, in the presence of a non-interactive experimenter during a sorting task (refer to **Section 2.4.2.1** for more details of the study). The speech content mostly comprised task-relevant descriptions of recently completed or ongoing activity, which could be meant for indirectly informing the experimenter about the progress of the task or any difficulties faced in the process. Such speech utterances can be an example of the **Type F** (private_communicative_other_product) speech profile, as tabulated in **Table 2.2**.

The study by Smith (2007), involved L2 learners who were engaged in a collaborative board game (refer to **Section 2.5.2.2** for more details of the study). They reported instances of social and private speech which can represent the **Type G** (social_preceding_self_product) and **Type E** (private_preceding_other_product) speech profiles, respectively, as shown in **Table 2.2**. **Type G** (social_preceding_self_product) profile corresponds to those social speech utterances reported in the study, which were meant to draw joint attention to a particular aspect of the problem, but they also triggered one's own thinking about the problem. The **Type E** speech profile (private_preceding_other_product) can be represented by an instance in the study, when private speech, meant to privately hold a particular word in focus, attracted the attention of a listener who got initiated into further action (Smith, 2007, p.353).

Table 2.2 Examples of speech utterances from the reviewed studies which correspond to each of the eight speech profiles derived from the Contextual Model of Speech Function.

Speech Profile	Study	Description of utterances
Type A (private_preceding_-self_process)	Furrow, 1984	• **private speech** under the functional category '**self-regulatory**': an utterance refers to an event that might be immediately carried out; the child is the stated agent or there is no agent and the child performs the action herself - for example, "I put that there" (Furrow, 1984, p. 358)
Type B (private_communicative_-self_process)	Furrow, 1984	• **private speech** under the functional category '**describing own activity**': an utterance refers to an ongoing or just completed event in which the child was involved - for example, "Putting it." (p.358) • **private speech** under the functional category '**expressive**': utterance content is an evaluative opinion, an expression of an internal state, or a stock phrase that expresses feeling- for example, "I love you." (p.358)
Type C (social_preced-ing_other_process)	Furrow, 1984;	• **social speech** under the functional category '**regulatory**': an utterance refers to an event that might be immediately carried out; another person is the specified agent or there is no agent and the child does not perform the action herself- e.g., "Go there." (p.358)

Table 2.2 Examples of speech utterances from the reviewed studies which correspond to each of the eight speech profiles derived from the Contextual Model of Speech Function.

Speech Profile	Study	Description of utterances
Type D (social_communicative_other_process)	Furrow, 1984; Goudena, 1987	• **social speech** under the functional category '**attentional':** an utterance refers to a sensory event that is ongoing or might be immediately carried out, e.g., "Look." (Furrow, 1984, p.358) • **social speech** under the functional category '**informative'** : an utterance which refers to a non-present object of event, e.g., "Daddy at work". (Furrow, 1984, p.358) • P13 (**social-directed-at-task-self-guiding(concluding)-non-interrogative-relevant**): "No, it doesn't fit" (Goudena, 1987, p. 201)
Type E (private_preceding_other_product)	Smith, 2007; Goudena, 1987	• **private speech**, meant to privately hold a particular word in focus, attracts the attention of a listener who is initiated into further action - e.g., "Hmm have I heard that word before?" (Smith, 2007, p.353). • P25 (**private-directed-at-task-self-guiding (planning)-non-interrogative-relevan**t): "This goes right in the corners" (Goudena, 1987, p. 201)
Type F (private_communicative_other_product)	Goudena, 1987; McGonigle-Chalmers *et al.,* 2014	• P27 (**private-directed-at-task-self-guiding (concomitant)-non-interrogative-relevant**): "That one is correct" (Goudena, 1987, p.201) • P29 (**private-directed-at-task-self-guiding(concluding)-non-interrogative-relevant**): "That one doesn't go in there" (Goudena, 1987, p.201) • **private speech,** as questions and comments regarding reflecting on current or past attempts: "Why doesn't it go in that box?" (McGonigle-Chalmers *et al.,* 2014, p.834)
Type G (social_preceding_self_product)	Furrow, 1984; Smith, 2007	• **social speech** under the functional category '**self-regulatory**': an utterance refers to an event that might be immediately carried out; the child is the stated agent or there is no agent and the child performs the action herself - for example, "I put that there" (Furrow, 1984, p. 358) • **social speech**, meant to draw joint attention to a particular aspect of the problem, triggers one's own thinking about the problem - e.g., "Is that the right word?" (Smith, 2007, p.353).

Table 2.2 Examples of speech utterances from the reviewed studies which correspond to each of the eight speech profiles derived from the Contextual Model of Speech Function.

Speech Profile	Study	Description of utterances
Type H (social_communicative_-self_product)	Furrow, 1984	• **social speech** under the functional category '**describing own activity**': an utterance refers to an ongoing or just completed event in which the child was involved - for example, "Putting it." (p.358) • **social speech** under the functional category '**expressive**': utterance content is an evaluative opinion, an expression of an internal state, or a stock phrase that expresses feeling- for example, "I love you." (p.358)

Hence, the examples from these studies, which correspond to the eight speech profiles (**Type A -H)** of the Contextual Model, show that speech utterances can have different functions for the speaker and the listener, due to the different task and context conditions. The Contextual Model proposed earlier was able to account for all kinds of speech utterances reported in these studies, which had been recorded under a diverse range of social and interactional contexts and task demands. Hence, the Contextual Model was able to efficiently capture the sensitivity to context in which spontaneous speech is produced. Therefore, the examples cited from the various studies and encompassed by this model make a strong case that the function of speech is governed not simply by the mere presence or absence of others in the vicinity, but is governed by the task/goal context that requires directing oneself and/or others. Furthermore, even within the broad demands made by the nature of the task on self or other-regulation, the specific cognitive features of a task, such as a heavy working-memory load in a task which requires rule-based planning and sorting, controlling impulsivity in a go/no-go task, perseverance in a task which requires manual dexterity, etc., can dictate the specific function that speech may be called upon to perform in the verbal mediation of behaviour. Hence private speech studies should reframe their guiding question from - "is private speech regulatory?" to "under what conditions is private speech regulatory?"

After spontaneously produced speech is classified into social and private speech, most private speech studies go on to classify the private speech utterances on the basis of one or more dimensions of speech (Winsler *et al.*, 2005). The various dimensions which form the basis of classification can be the physical or structural form of speech (e.g., degree of overtness or internalisation), the content of speech utterance (e.g., task-relevance and semantic content) or the context of speech (e.g., speech/conversational acts). There is no consensus yet on any one dimension being the most appropriate basis of classifying speech. However, the choice of the dimension which will form the basis of classification of speech in a study is crucial in correctly addressing a particular research question.

The various categories derived from these dimensions of speech, and the studies which have employed them, are described below. One of the major methodological issues in private speech research is the confusion between the various dimensions of speech, such that one dimension of speech (e.g., level of internalisation) is assumed to also represent another dimension of speech (e.g., task-relevance). This issue has also been elaborated below along with solutions for avoiding this confusion in new systems of classification.

2.5.3.1 Structural form of speech

While tracing the ontogenetic developmental trajectory of private speech, researchers (Berk, 1986; Kohlberg et al., 1968; Manning & White, 1990) found a rise in overt private speech utterances, reaching a peak during preschool years (3-5 years) and then declining gradually, appearing to be replaced by partially audible and semi-internalised whisperings and finally inaudible mutterings and lip movements by early primary school. Thus the levels of overtness of private speech have been assumed to represent the relative maturity or immaturity of private speech. Based on these findings, many private speech studies classified speech according to the dimension of structural form of speech, and its degree of overtness in particular. Hence they classified private speech into the following three categories, in descending order of internalisation of speech - loud or overt speech, semi-internalised whispers, and inaudible mutterings (Alarcon-Rubio *et al.*, 2014; Berk, 1986; Fernyhough & Fradley, 2005; Kohlberg *et al.*, 1968; Kraft & Berk, 1998; Lidstone, Meins & Fernyhough, 2011; Ostad & Sorensen, 2007; Winsler *et al.*, 2000). Most of these studies usually reported correlation between speech categories with higher level of internalisation and conditions that either require more advanced behaviour, i.e. a difficult task level, or other measures of greater

behavioural control. Hence internalisation of private speech was proposed to be associated with advances in regulation of behaviour.

2.5.3.2 Content of speech

The dimension of content encompasses different aspects of speech content, such as task-relevance, semantic content and pragmatic content. Classification based on task-relevance usually involves assessing the content of the speech for its direct relation to the task at hand. Hence while statements about objects and events related to the task as well as evaluations of one's performance or task difficulty may be classified as task-relevant speech, utterances such as word-play, repetitive sounds, singing and affective expressions are usually considered to be task-irrelevant. This system of classification is usually clubbed together with classification based on the form of speech, i.e., the degree of overtness of speech (Berk, 1986). The problem with classifying form and content of speech together under a single system of categorisation has been discussed later in **Section 2.5.3.4**.

Early on in the private speech tradition, methodologies which focused solely on the quantity or frequency of private speech utterances while examining their relation to mediation of behaviour were criticised (Frawley & Lantolf, 1986; Wretch, 1979) for ignoring the quality or content of the speech utterances, which might be more influential in determining how task-relevant behaviour is mediated by speech (refer to **Section 2.3.2** for a discussion on this issue). Hence, more studies in this tradition started classifying speech based on its semantic content, wherein several mutually exclusive and exhaustive categories were employed based on 'what is said' in the speech utterance (Berk & Spuhl, 1995; Copeland, 1979; Diaz *et al.*, 1992; Kraft & Berk, 1998; Damianova *et al.*, 2012; Rubin & Dyck, 1980; Winsler, 1998; Winsler *et al.,* 2003). In these studies, particular semantic categories such as future-oriented statements about the task, commands, questions referring to task-related objects and events were shown to be correlated with task-relevant behavioural measures or more advanced level of behavioural control in other situations. Hence the particular content of private speech was proposed to be associated with certain aspects of self-regulatory behaviour, under the assumption that the specific task-related content of an utterance may have a real-time mediatory effect on an aspect of task-related behaviour that accompanies the utterance. However, correlation findings can only assume real-time occurrence, while also being limited in examining the particular but ever-changing contexts in which such co-occurrences of speech and behaviour take place (refer to **Section 2.5.6** for a discussion on the limitations of correlational findings).

2.5.3.3 Context of speech

While the examination of the semantic content of speech is certainly a step forward in focusing on the role of the qualitative aspects of speech in verbal mediation of behaviour, such classifications are not able to distinguish between 'what is said' and 'what is meant' by the speaker within a conversation, situated in a particular context. Several researchers have argued that Vygostky's conceptualisation of verbal mediation of behaviour through private speech was primarily based on the effect that the meaning of the utterances had on behaviour rather than simply their rate of production (Feigenbaum, 2002; Frawley & Lantolf, 1986; Wretch, 1979). Further, according to Vygotsky, even the meaning of an utterance is not fixed or constant, but is dynamically created out of the movement between the act of thinking and the act of communication in words (Feigenbaum, 2002). Classifications of speech based on semantic analysis examine the semantic and syntactical aspects of individual speech utterances, divorced from the interactive and dynamic meaning-making context in which utterances are produced as a part of a turn-taking conversational structure. For example, utterances produced in the syntactical form of a question, such as - "*Why don't you give it a try?*" may be classified as a question in a system based solely on the semantic content and syntactical structure of speech. However, when seen in the context of the entire conversation within which such an utterance is produced, it is clear that the utterance is a statement directing or suggesting someone to do something rather than asking them the reason for not making an attempt to do it. If more information about the speaker and the listener is also taken into consideration, one can further clarify that such an utterance was meant to be a command (albeit in a polite and encouraging conversational style) rather than a suggestion, if the speaker was a teacher directing a child to tidy-up a play area which the child had initially refused on the pretext that it was a difficult task. This example proves that features such as the intention of the speaker, the context in which the utterance is produced, and the conversational style and skills of the speaker are crucial in establishing 'what is meant' by an utterance. Therefore, in the above example, the knowledge that the question-like statement was 'meant' as a command in the given context can help in establishing the relation of this utterance with its accompanying behaviours, both by the speaker as well as by the listener. Hence the pragmatic meaning rather than the semantic content of speech may be crucial in understanding the phenomenon of verbal mediation of behaviour.

Such a discursive and pragmatic approach to classifying speech originates from the theory of *speech acts* proposed by Austin (1962) and Searle (1969). According to Austin (1962), a *locution* refers to 'what was said' in an utterance, while an *illocution* refers to 'what was meant' by the

speaker, while the effect of the illocution is termed as *perlocution.* Thus, an *illocutionary act* or *speech act* can be defined as an utterance which performs a certain 'action' through the act of speaking something with a particular intention of causing the action, in contrast to a linguistic act which only involves saying something meaningful in a language. Hence, we perform numerous actions such as - making claims, taking oaths, apologising, criticising, requesting and so on, simply by saying certain words. Intrinsic to a speech act is the *intention* of the speaker to produce a desired 'action' through its utterance. The intention with which a speech act is delivered was termed as the *illocutionary force* by Searle (1969). Only by attending to both the linguistic features of the utterance as well as it illocutionary force, can the listener fully comprehend and recognise a speech act. The response that the listener makes to the speech act as an effect of the illocutionary force was defined as the *perlocutionary effect.* Several researchers have since used the concept of speech acts in categorising utterances on the basis of the intended meaning (i.e., *illocutionary force*) and effect of an utterance (i.e., *perlocutionary effect*) spoken in a given context (Bruner, 1975; Dore, 1977; Feigenbaum, 1992; Furrow, 1984; Grice, 1975; Searle, 1979). Some of these categories suggested by Searle (1979) are as follows: *assertives* (utterances through which the speaker intends to assert the truth of a proposition, e.g. claiming, insisting, swearing, deducing, boasting, etc.), *directives* (utterances through which the speaker wants the listener to do something, e.g., asking, begging, requesting, suggesting, commanding, inviting, pleading), *commissives* (utterances through which the speaker commits to a future course of action, e.g., promising, pledging, proposing, etc.), *expressives* (utterances through which one's emotional and affective state in a certain condition is expressed, e.g., apologising, congratulating, thanking, deploring, commiserating, welcoming, etc.) Since speech acts are necessarily embedded in the particular culture and context in which they are used, there is no consensus on the exhaustive list of all categories of speech acts that are used in any particular language. Hence classification systems vary in their particular set of categories, depending on the focus of the study itself.

2.5.3.4 Confusion between form, content and function of speech

Private speech studies have usually employed more than one dimension of speech in classifying their speech utterances. While in some cases, two or more dimensions of speech would be independently coded (Azmitia, 1992; Goudena, 1987; Kraft & Berk, 1998; Winsler, 1998; Winsler *et al.,* 2003), many studies have combined these dimensions in one construct. One such example is the three-level coding system developed by Berk (1986), which is one of the most widely used typologies for private speech (Berk & Spuhl, 1995;Fernyhough & Fradley, 2005; Lidstone, Meins

& Fernyhough, 2010; Winsler, 1998; Winsler et al., 2003). Here, the degree of internalisation of private speech (dimension of form) has also come to include the concept of task-relevance (dimension of content). The content of those loud utterances, which are not related to the task that the child is engaged in, are termed as *task-irrelevant* (Level I), and are assumed to be the most immature form of private speech. Next in this proposed developmental hierarchy are the overt utterances which are related to the task, and are called *task-relevant* (Level II) private speech. The most mature level of private speech includes whisperings or lip movements, which are considered to be the external manifestations of inner speech (Level III). Although the content of the inaudible speech at Level III cannot be examined for task-relevance, it is assumed to be task-relevant, based on the assumption that it is the most mature form of private speech before it is completely internalised. Thus, the dimensions of form and content are assumed to be overlapping and synonymous.

The categories of task-relevant and task-irrelevant speech indicating content of private speech have also been assumed in some cases, as synonymous with 'self-regulatory' and 'non self-regulatory' private speech, respectively (Frauenglass & Diaz, 1985), thus inferring function from content. However, utterances such as word-play, repetition and affective expressions which may not appear to be goal-directed or even directly related to the task, may actually perform functions such as directing or sustaining attention during the task, or attributing responsibility for task failure to the external environment, thereby performing a task-relevant and self-regulatory role (Frawley & Lantolf, 1986). Assuming *a priori* that certain forms of speech have particular functions can lead to misleading conclusions about the role of private speech in verbal mediation of behaviour. Hence there have been persistent demands in the private speech literature to address the confusion between the form/content and function of private speech (Atencio & Montero, 2009; Diaz, 1986; Frawley & Lantolf, 1986; Matuga, 2003). By attributing inferred functional categories to the structural form or semantic content of private speech in coding schemes, several important studies (Berk & Spuhl, 1995; Fernyhough & Fradley, 2005; Frauenglass & Diaz, 1985) have failed to adequately differentiate between the various dimensions of children's private speech. Hence, more carefully constructed taxonomies which measure the various dimensions of speech independent from each other, as well as independent from any proposed function of speech need to be formulated, in deriving sound conclusions about the role, if any, of spontaneous speech in children's verbal mediation of behaviour. Researchers (Atencio & Montero, 2009; Diaz, 1986, 1999; Matuga, 2003) have also suggested the use of behavioural measures which are independent from the speech

measures, in order to examine their association with different categories of speech.

2.5.4 Speech within a pretend play framework

Very few studies in the private speech literature have observed children's private speech use during free-play activities (Krafft & Berk, 1998; Rubin & Dyck, 1980). However, there has been a longstanding tradition of observing the language of play in areas of research related to children's play. The language used particularly during pretend play situations has always been of special interest, for the novelty of their content that mostly comprises fantasy-based themes, references to non-present and imaginary objects and events, and verbal transformations of existing objects and spaces into pretend objects and spaces (Bretherton, 1989; Berk, Mann & Ogan, 2006; D'Orazio, 1994; Giffin, 1984; Garvey & Kramer, 1989; Sawyer, 2003; Whitebread & O'Sullivan, 2012). Hence, due to the peculiar content of pretend play speech, different methods of classification and analysis have been suggested by these studies to comprehend the phenomenon of pretend play speech. Even the developmental trajectory of private speech recorded within pretend play scenarios has been observed to be different from other types of private speech recorded in non-pretend situations. While all other types of private speech, particularly observed during problem-solving, become more abbreviated, less audible, and appear to become internalised (Behrend et al., 1992; Berk, 1986; Berk & Landau, 1993; Duncan & Pratt, 1977; Manning & White, 1990; Winsler et al., 2003), private speech observed during pretend play, instead of decreasing in amount and overtness, remained at a comparably high level (Berk, Mann & Ogan, 2006; Krafft & Berk, 1998).

The observational study by Krafft & Berk (1998) explored the relationship between different types of play activities and the use of private speech, in two preschool programmes differing in their approach to free-play in learning. While the children in the preschool which encouraged free-play engaged in significantly more pretend play and private speech; even across the two schools, the strongest correlation was found between pretend play and self-guiding private speech. The most common type of private speech observed by Krafft & Berk (1998) was "fantasy play speech" comprising of only role-play verbalisations during pretend play situations. However, the use of a single category of private speech for a host of different types of role-play utterances within the pretend play context does not do justice to a mixed group of speech types that have been functionally differentiated in the play literature (Giffin, 1982, 1984; Garvey & Kramer, 1989). Utterances in the pretend situation can change their form quickly from enactment to plot-management (Bretherton, 1989), such as transformation of identities, objects and spaces with the

pretence context (D'Orazio, 1994). At times, certain role-play verbalisations may even function in an "ulterior" manner (Bretherton, 1989; Giffin, 1984) as plot-changing utterances, while continuing to pretend. These examples of pretend play speech used for controlling the pretend play situation have been termed as 'metacommunication', or 'communication about communication' (Bateson, 1976; Giffin, 1982; Sawyer, 2003), and have been proposed to be important for the development of metacognitive and self-regulatory skills in children. (Whitebread & O'Sullivan, 2012).

Bateson (1976) used the concept of a picture-frame to visualise the movement of children in and out of the play 'frame'. Giffin (1982) applied this concept to the pretend-play frame, wherein utterances within the frame may involve non-literal verbal behaviour, which are interpreted by the children differently from the literal utterances outside of the play frame. A continuum of metacommunication utterances in pretend play was developed by Giffin (1982), which traverses the pretend-play frame and is used to establish the play frame, manage the course of the play within the frame and alter the play frame by adding new elements of pretence. While some of those utterances in the continuum are spoken implicitly, within the pretend frame (*enactment*, *ulterior conversation*, *underscoring* and *storytelling*), others may be expressed explicitly, by stepping outside the frame (*implicit pretend structuring* and *formal proposals*). Classifying speech that occurs during pretend play in such a manner can distinguish between different types of role-play verbalisations, which may be used for different purposes, while appearing to have the same element of pretence.

2.5.5 Temporal order of private speech with behaviour

Apart from a change in the amount of private speech produced in children following an inverted U-shaped trajectory (Berk, 1986; Behrend *et al*., 1992; Berk & Landau, 1993; Kohlberg *et al*.,1968; Manning & White, 1990; Winsler et al., 2003), Vygotsky (1934/1987) had also hypothesised a change in the temporal order of children's private speech with respect to their action. He predicted that with development, private speech would precede action, wherein younger children would mostly use private speech after the completion of a task, as an afterthought, while with age, speech would first accompany action and then come before it, thus performing a planning function. Many researchers have since tried to find evidence for such a developmental trend in young children (Berk, 1992; Berk & Spuhl, 1995; Kohlberg et al., 1968; Matuga, 2003; Patrick & Abravanel, 2000), but only Kohlberg and colleagues (1968) found an age-related increase in speech that was meant for planning. However, most of these studies do not look at the actual timing of private speech utterances in relation to the actions co-occurring with them. Instead they categorise private

speech on the basis of their content into *a priori* functional categories such as *describing*, *planning*, *questioning, affect expression,* etc., and then calculate their correlations with age. Although Patrick and Abravanel (2000) noted the timing of a particular kind of private speech (repetition of the instruction given for the task) with respect to a single action in their story-sequencing task, and Matuga (2003) observed the temporal sequence of private speech in conjunction with behaviour related to a drawing task, both the studies did not manage to capture the whole range of possible temporal relations between speech and behaviour that may occur naturally during the daily activities of young children. Hence the hypothesis regarding the change in the temporal order of private speech with respect to behaviour remains to be verified using an appropriate methodology.

2.5.6 Limitations of correlational findings

Contemporary research on the function of private speech in mediating self-regulatory behaviour in children is mostly based on correlational findings between the absolute or relative frequency of private speech emitted during a task, and measures of task performance and levels of task difficulty acting as proxies for self-regulatory behaviour (Berk & Spuhl, 1995; Duncan & Pratt, 1997; Fernyhough & Fradley, 2005). These present a static picture of the relation between speech and behaviour, and are at best an assumption of any real-time interaction between speech and behaviour. If indeed the speech utterances do not co-occur with self-regulatory behaviour in real-time, then the correlations may either be representing some hidden variable such as an underlying trait influencing both speech and behaviour, or a mechanism involving speech and behaviour over a longer timescale. Either way, based on correlational findings only, there is no way of confirming or ruling out the various possible temporal interactions mentioned above. In contrast, Vygotsky's own observations (1934/1987) focused on the actual moments of difficulty arising due to the introduction of an impediment to a task, when private speech increased, and on the role of the content of private speech, not merely its frequency, in self-regulation of behaviour. Although Vygotsky's theoretical hypotheses regarding the relationship between private speech and self-regulation seem to be substantiated by these correlational findings, they are limited in their potential to delineate the underlying processes through which private speech utterances afford the control and monitoring of children's own behaviour (Kuvalja, Verma & Whitebread, 2014). Moreover, some researchers (Frawley & Lantolf, 1985; Wertsch, 1983) have argued for a more crucial role of the content of private speech, emitted during challenging situations, in determining how self-regulatory behaviour is mediated by private speech. Hence detailed qualitative analyses of the occasions when

different contents of private speech are articulated during observable self-regulatory behaviour can lead to an improved understanding of the mechanisms underlying real-time verbal mediation of behaviour (Alderson-Day & Fernyhough, 2015; Kuvalja, Basilio, Verma & Whitebread, 2013; Kuvalja, Verma & Whitebread, 2014).

2.5.7 Individual differences in private speech use

An area of inquiry that has been rarely investigated in private speech research is the presence of individual differences in the use of private speech, and their stability over time and across different contexts (Berk & Landau, 1993; Lidstone, Meins & Fernyhough, 2011; Winsler *et al.,* 2003). Its importance cannot be over emphasised, since large individual variations in the production of private speech have led researchers to even question Vygotsky's "universal stage-like nature of private speech" (Frauenglass & Diaz, 1985, p. 364). On the other hand, Frawley and Lantolf (1986) assumed individual variation to be the general principle of development. Far from being problematic for statistical purposes, they suggested that individual differences should be examined in detail in naturalistic settings to understand the broad principles behind this variation before experimenting with it in laboratories.

Berk & Landau (1993) compared the consistency of private speech use across different tasks (academic seat-work and puzzle-solving task) and settings (classroom and laboratory) for learning disabled (LD) and normally achieving students. For both groups of children, they reported a decrease in their private speech production during the laboratory-based puzzle task, when compared with their production in the classroom. However, the rate of speech between academic seat-work in the classroom and the laboratory were highly correlated. Hence they concluded that children's use of private speech was setting and task specific. A naturalistic study by Winsler and colleagues (2003) has provided systematic data regarding the stability and reliability of individual differences in preschoolers' private speech use across different tasks and over a 6-month period. Further results also indicated associations between individual differences in the production of private speech (categorised on the basis of relevance to task) in two lab-based tasks and observed self-regulatory behaviour in the classroom, wherein those children who largely used task-irrelevant private speech in the tasks exhibited poorer goal-directed and social behaviour in the class. While these results are significant for further understanding the use and effectiveness of private speech for children with problems of self-regulation and behavioural control, the *a priori* categorisation of private speech as irrelevant to task, simply based on the content of speech rather than the accompanying behaviour

(refer to **Section 2.4.3.4** for a discussion on this issue), may lead one to make simplistic conclusions about the relation between the content of speech and self-regulatory behaviour in children. Another study by Lidstone, Meins & Fernyhough (2011) reported consistency of private speech production across various types of tasks (Tower of London, digit span task, spatial IQ task and academic numeracy task) and settings (laboratory and classroom) over two time-points separated by a period of 11 months. Hence the general evidence seems to point towards a stable, domain-general individual ability of producing private speech while engaged in challenging tasks that require self-regulation. However all of these studies characterise individual differences of private speech use in terms of the rate of production of private speech in relation to behavioural constructs. Not much is known about the individual qualitative styles of private speech use in the verbal mediation of behavior, such as employing specific content of private speech utterances in conjunction with specific types of self-regulatory behaviour in a fixed temporal order. If individual differences in private speech use are indeed related to self-regulatory behaviour in young children, then more information about the qualitative styles of private speech use rather than the rates of production of different types of private speech might hold the key to designing interventions for improving self-regulatory behaviour in early childhood.

2.5.8 Private speech in a social context

Vygotsky's conceptualisation of the social origins of private speech has led many researchers to investigate the effect of private speech production in the presence of others (Berk & Garvin, 1984; Goudena, 1987; Kohlberg et al., 1968; Krafft & Berk, 1998; McGonigle-Chalmers *et al.*, 2014; Winsler *et al.*, 2000). Some studies have found private speech to occur more frequently during the presence of peers rather than when alone (Kohlberg et al., 1968; Krafft & Berk, 1998), while others have found private speech to be suppressed by the presence of a vigilant or involved teacher (Berk & Garvin, 1984; Krafft & Berk, 1998). Winsler, et al. (2000) found that preschoolers observed in the classroom were less likely to use private speech when a teacher was present than when they were either with peers or alone. Based on these findings, it is generally assumed that the presence of an adult acts as a source of external regulation over the children's behaviour, which restrains their own efforts at self-regulation, and hence lowers their production of private speech. Further investigating the type of interaction between the child and the adult during a problem-solving session, Goudena (1987) reported a greater production of private speech in the presence of a non-interactive adult who had been collaborative during the training session earlier, rather than an adult

who had been non-collaborative in the previous training session. This clarified that the mere presence of an adult did not necessarily compel children to abandon their own efforts at self-regulation. It was the type of interaction between the child and the adult which either made them feel supported by the adult presence and hence encouraged them to self-regulate, or which discouraged them from self-regulation due to a feeling of being unsupported or externally regulated. Goudena however proposed an interactional interpretation of this data, wherein private speech had a dual nature, one as self-guidance during problem-solving and the other as an indirect plea for help towards the adult, who had been helpful in the previous interaction. This emphasizes the importance of considering the effects of the interactional framework between the child and the experimenter during experimental conditions in which children solve tasks. The mere presence of an experimenter may not necessarily provide the proper social framework for children to feel supported as well as capable of self-regulation.

In a more recent study by McGonigle-Chalmers *et al.* (2014), it was reported that both preschoolers and adult participants produced more private speech in the presence of a non-interactive experimenter, than in the absent condition, while engaged in a sorting task. However, upon examining the content of the private speech utterances, the researchers reported that they were mostly a commentary on ongoing or just-completed events, rather than a verbalisation of problem-solving strategies. While not necessarily denying the fact that commentary of events may also be relevant in solving the task through reflection on previous actions, they do propose a close monitoring of the social context in which private speech is produced, since it may have "a strong bearing on how we interpret the true function—and reason for—what is being said" (McGonigle-Chalmers *et al.,* 2014, p.835).

It is pertinent to point out here that the social context may not only involve the mere presence of peers or other adults, but also the nature of their presence, either as by-standers, collaborators or external regulators. When seen in the context of self-regulation towards a particular goal of an activity or task, the varying nature of the presence of others may be translated into the varying nature of their involvement in the goal of the activity towards which the child is regulating his behaviour. Hence if the goal of an activity is shared by a dyad or a group, then the function of private speech utterances of a child in this group may also need to account for the involved presence of others in the shared goal, and the need to regulate their behaviour towards the common goal. However, if the individual is in the presence of peers, but involved in a goal that is not shared by others, the nature of private speech utterances might still be influenced by the presence of others,

but the need would be more communicative or interactional - of simply informing others of the task progress, rather than regulating their behaviour. So far, no study investigating the functions of private speech has explicitly taken the nature of goal-sharing into account when considering the social context or peer presence. However, the dynamics of group activity, driven by a commonly-shared goal or by various individual personal goals has been extensively investigated in the self-regulation literature, when examining regulation in a collaborative learning context (Grau & Whitebread, 2012; Hadwin & Oshige, 2011; Järvelä & Hadwin, 2013; Schoor, Narciss & Körndle, 2015; Volet, Vauras, & Salonen, 2009). Research in this area firstly differentiates between various social modes of regulation in a collaborative context. Although some terms may have been interpreted differently by certain researchers, there is a general consensus on the definition of the three modes of regulation in a collaborative context, namely, *self-regulation*, *co-regulation* and *shared regulation.* Using the concept of *I, you* and *we perspectives* describing the spectrum of *sharedness* of goals, Järvelä & Hadwin (2013), defined these terms in the following way. *Self-regulation* involves all the processes by which individuals construct personal goals from an *I/my perspective,* and monitor, evaluate and adopt their own strategies that individually contribute towards a group task. On the other hand, *co-regulation* involves all the processes by which individuals support each other's self-regulation by monitoring and regulating others against goals from a *you/your perspective,* so that others also successfully contribute in a group task. *Shared regulation* involves the entire group to co-construct shared goals from a *we/our perspective,* and use monitoring and control strategies for regulating the activities of the entire group as a whole. Hence from the perspective of the demands created by personal, other's and shared goals, spontaneous speech (both private and social) may be used differently when involved in one of the three modes of regulation described above. The different styles of verbal mediation of behaviour directed towards the three types of goals, is a line of enquiry yet to be systematically explored.

2.6 Summary of the literature review

This literature review has attempted to bring together the strands of research in the areas of self-regulation and private speech in order to develop a richer understanding of the different processes that occur during the production of private speech. With this aim, the review highlighted theoretical and methodological issues with core definitions and operationalisation of basic concepts into measurable constructs, both in the self-regulation and the private speech literature. These issues influenced the conceptualisation of the research questions in this study, and the specific methodologies that were adopted for addressing those questions.

The first part of the review focused on the theoretical aspects of self-regulation and private speech. To begin with, a review of the various research traditions that have investigated and elaborated upon the construct of self-regulation, revealed the different foci of the sociocultural, cognitive and social cognitive traditions on the origins, core processes and dynamic influences on the phenomenon of self-regulation, respectively. The review also pointed towards a critique of many of the models of self-regulation as being based on evidence from older learners, and not developmentally suited for observing self-regulatory behaviour in young children. Further, evidence from research investigating the development of self-regulatory behaviour in even younger children and infants, compels us to adopt more developmentally sensitive models of self-regulation.

From a number of language-use behaviours, and their association with self-regulation and related constructs of behavioural and cognitive control, the review drew the focus on real-time verbal mediation of behaviour and a particular type of language-use, namely private speech, and broadly speaking, spontaneous speech. The various theoretical perspectives on the phenomenon of private speech were critically analysed, from Piaget and Vygotsky, to later and then more contemporary research by a whole tradition of private speech researchers, who have investigated various aspects of private speech use in young children.

As contemporary studies have come to commonly adopt frequency counts and rates of productions as the standard metric for observing the phenomenon of private speech, the assertions of earlier researchers (Frawley & Lantolf, 1986; Kohlberg et al., 1968; Wertsch, 1983) regarding the quality, rather than the quantity, of private speech affecting behaviour, came sharply into picture. The limitations of the quantitative approach in reporting correlations between the mean rate of private utterances and average values of different task variables (e.g. performance, difficulty) in examining real-time verbal mediation of behaviour, further emphasised the need to make a move towards

employing more qualitative methods of analysis, which are also temporally sensitive to the real-time component of the phenomenon.

The second part of the review highlighted the methodological issues involved in the assessment of self-regulation and private speech, and made suggestions for changes in these methodologies. The first suggestion for private speech studies made a strong case for directly observing the dynamic process of self-regulation in young children rather than measuring the end product of self-regulation through variables such as task difficulty and performance. The limitations of observing behaviour, both in naturalistic settings such as a classroom, and in standardized laboratory-based tasks, were pointed out. Suggestions were hence made for systematically observing open-ended behaviour in naturalistic settings and developing naturalistic and meaningful laboratory-based tasks for young children. The suitability of the Nelson and Narens' (1990) model of metacognitive processing for observing the dynamic processes of monitoring and control in the self-regulatory behaviour of young children was further indicated in the review.

In terms of the definitions and classifications of social and private speech, the inclusion of the criterion of 'adaptedness' along with 'addressivity', for distinguishing social and private speech forms was suggested. Attention was also drawn to the need for further examining both of them together while investigating the real-time verbal mediation of behaviour. The review also questioned the significance, if any, of the *a priori* functional differentiation between social and private speech through contrasting evidence from various research studies, and proposed instead, a Contextual Model of Speech Functions, for determining speech functions based on the dynamic context in which an utterance is produced. Correspondence between the various types of speech profiles generated by the Contextual Model and the examples of distinct types of speech use reported in the studies reviewed earlier, made a strong case for adopting the proposed model, and hence, examining the context of speech utterances in determining their function.

Further in the review, the various dimensions of speech (form, content and context of speech) which have been considered while classifying speech in private speech studies were discussed. This was followed by a critique of certain classification schemes which have either appropriated different dimensions of speech into a single system of categories, or conflated the dimensions of speech with their supposed *a priori* functions, without assessing the actual effect of such speech use on behaviour in a given context. Suggestions made by various researchers in addressing this issue were pointed out here. They advocate the practice of determining the function of speech by making

independent assessments of speech and behaviour, and carrying out detailed contextual analyses of the actual instances when speech occurs in moments of difficulty that require self-regulation. No systematic study incorporating these suggestions has been conducted as yet.

The review also examined the small number of studies that have investigated the individual differences in the production of private speech, and the stability of these individual differences over time, and across different contexts and tasks. However, the need to investigate individual differences in the qualitative style of speech use in conjunction with task-relevant behaviour, observed in children within different contexts was also stressed, especially for informing the design of interventions sensitive to the qualitative individual differences in the verbal mediation of behaviour.

2.7 Current study

The current study attempted to incorporate the various conclusions and suggestions made by the literature review in developing its theoretical basis, and thus, informing the methodology chosen for the conducting the study and determining the subsequent data analysis techniques used. While the details of the methodological features of the current study and the techniques for data analysis are discussed in the next chapter on the methodology of the study, a brief outline of the ways in which the literature review shaped this study is given below.

To begin with, the conceptualisation of self-regulation in this study was informed by all three traditions in which self-regulation has been examined. The link between the ontogenesis of private speech and the development of self-regulation in childhood, and the overarching concept of 'verbal mediation of behaviour' used in this study were derived from the Vygotskian socio-cultural tradition of research. However, the features of the processes involved in self-regulation, particularly, as observed in young children, were derived from the models of self-regulation developed within the cognitive/information processing tradition as well as the social cognitive approach of Bandura and others. Hence, the study made an attempt to develop an integrative approach towards examining self-regulation in young children, by combining the desirable concepts and features of all the three traditions discussed in this chapter.

 Based on the conclusions made about the appropriate settings for observing young children's self-regulation, preschool children were directly observed during their daily self-initiated goal-directed activities in the classroom as well as in a meaningful task embedded within a play session in a

laboratory setting. In order to systematically observe the dynamic self-regulation exhibited by children within the goal-directed activities in the classroom and in the laboratory-based task, the constantly changing control and monitoring processes expounded in the Nelson and Narens' (1990) model were incorporated into the coding scheme of the study. Inspired by the emphasis placed in the social cognitive tradition on examining individual behaviour as being reciprocally influenced by the environment in which it is placed, the dynamic context of the goal-directed activity involving peripheral behaviour and task-related events were also recorded through the coding scheme. Furthermore, influenced by the research looking into social modes of regulation in collaborative tasks, the impact of the goal-sharing context was considered while observing verbal mediation of behavior. Similar suggestions from the theory of speech acts informed the construction of the classification system of speech used in the study, which was based on the contextual and pragmatic content of the speech utterances rather than their semantic content.

Conclusions from the literature review were also incorporated into the methods of data analysis used in the current study. Compelled by the limitations of investigating real-time verbal mediation of behaviour through correlational findings, as pointed out in the review, the study adopted the technique of analysing temporal relationship between speech and behaviour through their co-occurrence in recurring temporal patterns. Fine-grained contextual analysis of the recurring speech-behaviour pairs in the recorded data was also adopted for examining the nature of real-time verbal mediation of behaviour. The Contextual Model of Speech Functions formulated through the critical review and evidence from studies examined in the literature review, were later employed to compare its predictions in the specific context of this study with the findings obtained through the temporal analysis carried out in this study.

Finally, due to the small number of participants in the study, consistency of group differences, instead of individual differences, was examined in a measure of verbal mediation of behaviour represented by the frequency of private speech use in conjunction with goal-relevant behaviour within recurring temporal patterns. This measure was compared with other measures of successful self-regulation in the classroom and laboratory settings. Furthermore, detailed contextual analyses of the patterns of speech and behaviour typical to each group were carried out in order to investigate the qualitative differences in the styles of private speech use co-occurring with goal-related behaviours.

Chapter 3. Methodology

3.1 Introduction

This chapter begins by laying out the overall rationale of the present study. This is followed by a discussion of its three specific research aims and the three research questions derived from these aims, along with the proposed hypothesis for each question. Before going forth into the specific methodology used in the study to answer these research questions, the next section highlights those methodological issues that had been identified in the private speech and self-regulation research in the Literature Review in Chapter 2 and describes how they were addressed in the current study through the use of innovative methods of data collection, categorisation and analysis. The next section titled 'Research Design' describes how the present study was conducted, by sketching out the details of the two settings (classroom and laboratory) in which the research was carried out, the details of the participants, and the procedure carried out to collect the data in the two settings. While the development of the coding framework used in this study has been discussed in the next chapter, as part of the General Results, the procedure for calculating the inter-rater agreement for the coding framework are discussed next. This is followed by the section titled 'Data Analysis', which describes the general techniques of analysis used throughout this study, especially the t-pattern analysis used in this study to extract recurring temporal patterns within the behavioural data. The specific ways in which these techniques are employed in the present study to analyse data pertaining to each research question are described in the subsequent chapters.

3.2 Rationale

The rationale for the research questions raised in the present study have come from the various theoretical and methodological issues raised in the review of previous research which was discussed in Chapter 2. The process through which the research questions for this study took shape have been described below.

The theoretical basis of this project comes from private speech research which has provided substantial evidence for the self-regulatory function of private speech in young children. However as suggested in **Section 2.5.2** of the Literature Review, verbal mediation of behaviour cannot be investigated fully while leaving aside the role of social speech. Hence while references to past

research have been made to private speech only, all research questions raised in the present study involve the contents of both social and private speech alike, and will be described together as children's spontaneous speech.

The review of contemporary research in the areas of self-regulation and private speech shows an implicit interaction between behaviour and speech. However, in most studies, their interaction is assessed through a static framework of statistical correlations between them. Such a framework does succeed in showing some relatedness between these phenomena, but leaves out the dynamic interactions between them. Moreover, the mechanisms underlying these interactions also need to be investigated using an appropriate method, since correlational findings fail to provide any causal explanations. Hence it is imperative to examine the temporal interactions in real-time, between spontaneous speech and self-regulatory behaviours during children's daily activities. Moreover since correlations simply assume the co-occurrence of private speech and self-regulatory behaviour, actual temporal co-incidences between these phenomena need to be established. The results of my MPhil study (Verma, 2010) confirmed the presence of several co-incidences between various semantic categories of private speech and types of cognitive, emotional and motivational self-regulatory behaviour during preschool classroom activities. However, any attempt at exploring the processes governing these specific instances of co-occurrence can only be made when significantly recurring temporal patterns of co-incidence emerge between children's speech and behaviour. If children's speech does mediate their behaviour directly in real-time time rather than through some other developmental process that we cannot observe in the present set up, then there is a possibility of finding a recurring temporal pattern of co-incidences between speech and behaviour. Hence the primary question guiding my research is whether such patterns of co-incidences exist during children's daily classroom activities, and what do they look like? These temporal patterns may not solely consist of a binary of speech and behaviour, but may include higher-order patterns of several instances of speech and behaviour occurring in a sequence. *T-pattern analysis* (Magnusson, 2000) is a powerful method of extracting significantly recurring temporal patterns (termed as *t-patterns*) embedded within a stream of behaviour. This method of temporal analysis was used in the present study to extract real-time temporal interaction between various speech and goal-related behavioural categories. These patterns of co-occurrence between the various speech-behaviour pairs were compared with correlations between the same speech-behaviour pairs. Those pairs which correlated during an episode as well as co-occurred in real-time temporal patterns within the episode were taken as stronger indicators of real-time verbal mediation rather than simply overall correlated

frequency of production. Further qualitative analyses of such correlated and co-occurring pairs within t-patterns were undertaken to examine the context in which such patterns emerge, and discern specific kinds of real-time verbal mediation of behaviour involved in each case.

The advantage of carrying out context-sensitive qualitative analyses of t-patterns was used to address another question that is often asked in private speech research. Is the function of private speech truly self-guiding? Does it have any other functions such as communication? Are these functions non-overlapping with functions of social speech, which are assumed to be strictly communicative? Does social speech have any self-regulatory functions? Review of previous research from both the cognitive tradition as well as research in second-language acquisition has shown that private and social speech can have multiple and overlapping functions, depending on the context in which they are produced (refer to **Section 2.5.2.1** and **Section 2.5.2.2** in the **Literature Review** for a review). Based on the evidence provided by these studies, the Contextual Model of Verbal Mediation (which comprises both private and social speech) was developed in **Section 2.5.2.3**. In the model, both 'private' and 'social' speech (designated in the model as *forms of speech*) can be produced as either 'preceding' or 'following' relevant behaviour (designated as *timing of speech*). Both the functions can act upon the 'self' or the 'other' (designated as *sites of action)*, depending upon whether the speech performs those functions directly - as a 'process', or indirectly- as a 'product' (designated as *means of action*). While the presence or absence of others in the vicinity could determine the context in which speech can have a specific function, what is crucial within a context is whether it requires directing oneself and/or others. Therefore, even in the presence of others, what may determine the function of speech might be whether a goal is pursued personally or the goal is shared with others (refer to **Section 2.5.8** in the **Literature Review** for a review of the issues involved in examining speech produced in the social context). Hence, before examining the verbal mediation of behaviour by private and social speech, one needs to determine whether the goal-sharing context may influence the way in which verbal mediation of behaviour takes place. If such an influence is found, then all subsequent analyses would have to take the context of goal-sharing into account.

Finally, researchers in the private speech literature have often commented on the highly variable rate of production of private speech in young children (Diaz, 1992; Fuson, 1979), with some children hardly producing any private speech within the same context. There has been a continuing discussion in the literature on whether this is a result of the children being observed at different stages of their individual developmental trajectory of private speech use or are there discernible

individual differences in the way in which verbal mediation of behaviour takes places in the first place. While longitudinal studies have tried to investigate the former (refer to **Section 2.3.3** in the **Literature Review** for an overview on the developmental trajectory of private speech), a systematic comparison of the different ways in which individual children employ verbal mediation as a strategy for self-regulation is largely missing. Correlational methods are limited in their scope to carry out such analyses, since they cannot capture the specific moments in time when speech is produced in conjunction with certain behaviours. Hence the contextual analysis of the t-patterns of speech and behaviour obtained from individual children, while they are engaged in goal-directed activities can reveal similarities across various task conditions. Qualitative comparisons between the patterns of behavior demonstrated by individual children or groups of children may be able to reveal different styles and levels of complexity of verbal mediation of behaviour.

Hence under the broad aim of examining real-time verbal mediation of behaviour through temporal patterns of speech and behaviour in preschool children, three specific research questions were asked in this study.

3.3 Aims & Research Questions

The aims of the current study can be summarised as follows:

a) To investigate the verbal mediation of behaviour through private and social speech in preschool children using a method that can extract real-time temporal relationship between speech and behaviour in recurring patterns

b) To consider the effect of goal-sharing as a contextual factor in determining the type of verbal mediation that may take place through social and private speech in a naturalistic environment

c) To explore individual differences in verbal mediation of behaviour, amongst preschool children

To examine these issues, the following research questions were asked in the present study:

Research Question 1: *Does the context of shared versus personal goals influence the occurrence of private and social speech during goal-oriented episodes?*

Hypothesis 1: Private and social speech would not show a difference in their rate of production between shared goals and personal goals since both types of speech can be used in the two goal contexts for regulating and communicating with oneself and with others. However the two goal contexts might show differences in the way they occur in conjunction with certain types of behaviour, namely those related to regulating others directly or indirectly in the shared context, as opposed to the personal context.

Research Question 2: *What is the role of task-relevant private and social speech in the verbal mediation of behaviour in the two goal-sharing contexts?*

Hypothesis 2: Task-relevant private and social speech would positively correlate with certain behaviours indicating successful self-regulation, and would additionally co-occur with a subset of these behaviours in temporal patterns, indicating either real-time verbal control or verbal commentary, depending upon the sequence and context in which speech and behaviour occur in the pattern.

Research Question 3: *Are there any consistent individual differences in the verbal mediation of behaviour through private speech?*

Hypothesis 3: Children would differ consistently, both quantitatively and qualitatively, in their level of verbally mediated self-regulation during goal-directed episodes, both in the classroom and the laboratory. Qualitatively, a higher level of verbally mediated self-regulation would involve more frequent and unique types of temporal patterns comprising task-relevant speech and goal-related behaviour. Whereas, qualitatively, it would be expressed in more sophisticated forms of self-regulation involving monitoring for error and error correction.

3.4 Methodological Issues Addressed in the Study

Since the principal aim of this study was to identify instances of real-time verbal mediation of behaviour through temporal patterns of regular co-occurrences between speech utterances and goal-directed behaviour in children, the research questions raised in the study required a methodology suitable for capturing real-time temporal interactions between speech and behaviour. However the methods used in the study also attempted to tackle some of the additional methodological issues which were pointed out after reviewing the existing literature. The corresponding methods adopted in the present study for addressing these issues are highlighted below. Hence, described below are the novel techniques of data collection as well as data categorisation and analyses, which were adopted by the present study, due to their suitability for capturing the dynamic temporal interactions between speech and behaviour.

3.4.1 Examining speech and behaviour simultaneously

Instead of establishing indirect relationship between speech and self-regulatory behaviour using correlations between the overall frequency of speech and self-regulatory behaviour, while assuming that they co-occur, the actual moments of difficulty in a task when speech and self-regulatory behaviour frequently coincide were examined in this study. While temporal co-incidence does not imply causation, it is a step forward from the static framework of correlational studies, towards investigating the contexts accompanying these dynamic temporal interactions and hence delineating the possible mechanisms underlying them.

3.4.2 Directly observing goal-directed behaviour

In the present study, self-regulatory behaviour in the context of goal-directed behaviour was directly observed, as they occurred spontaneously during the daily classrooms activities, instead of using variables like task difficulty, task performance or indirect measures of children's behaviour as proxies for self-regulatory behaviour in a particular situation (refer to **Section 2.4.1** in the **Literature Review** for a discussion on the problematic use of task variables as proxies for self-regulatory behaviour). Moreover, children were systematically observed while they exhibited self-regulatory behaviour, instead of relying on self-reports, questionnaires or teachers' and parents' descriptions. This method should enrich the general construct of self-regulation employed in contemporary models of self-regulation which have hitherto relied mostly on introspective reports given by older children and learners.

The framework of 'goal-directed behaviour' was adopted in this study to observe the spontaneous production of self-regulatory behaviour aimed at attaining a distant goal in the future. Such a goal needed to be separate from the means used or the activity carried out to achieve that goal. Hence, goal-directed behaviour can be considered as an expression of self-regulation at the highest level of complexity, since self-regulation of lower-level behaviour can also be displayed in an activity carried out for its own sake and not for a distant and defined goal.

Another advantage of using the framework of goal-directed behaviour is that it enables a systematic coding of behaviour expressed in diverse goal-directed activities. The construct of self-regulation requires the identification of categories such as -'self' and 'other' and regulation which has been either initiated or conducted, or both, by self/other. Moreover, one also needs to identify the regulation of particular domain which is being investigated, such as, behaviour, emotions, motivation or cognition. While examining these domains separately may be a methodological necessity, they may not be so easily separable in the naturalistic context. On the other hand, goal-directed behaviour does not need the identification of a 'self' which is initiating/regulating/directing any behaviour, but simply the identification of a goal towards which actions are directed, either by self or supported by others. The exact content of such a goal may again vary, depending upon the focus of the goal being social regulation (e.g., being included in a game that is being played by others), emotion regulation (e.g., preventing one's emotional outburst when one's bid to be included in the game is rejected by others), motivation regulation (e.g. persisting in finding new ways to be included in the game), etc.

Hence, the identification of the current goal was crucial in such a framework. One had to firstly determine the shared or personal nature of the goal in a social context. Secondly, the goals were identified on the basis of the child's perspective, usually involving those goals which were meaningful to the child. But also for the sake of maintaining some objectivity in the observation, only those goals which could be easily perceived by others/onlookers were recorded.

Another aspect of self-regulatory behaviour is that it is effortful. It cannot be a description of automatic, learnt behaviour, but must describe behaviour which requires some on-going conscious effort. Hence latent goals, which the children were not aware of, and hence, which were not under their conscious control were not coded. Similarly, goal-directed behaviour which involved automatic responses in achieving a repeatedly pursued goal was not recorded in this study. Hence the focus of the study was only on those goals which the children seemed to be actively and

consciously pursuing.

3.4.3 Categorising speech content based on context

In the socio-cultural tradition, verbal mediation of behaviour has been conceptualised through the effect that the meaning or content of the utterances has on behaviour (Wretch, 1979; Frawley & Lantolf, 1986, Feigenbaum, 2002). Hence this study adopted the dimension of the content of speech in its coding framework, in order to investigate the phenomenon of verbal mediation of behaviour. However, the content of speech can be semantic or pragmatic in nature. While the former is concerned with 'what is said', the latter is concerned with 'what is meant'. The advantage of categorising speech based on its pragmatic content and derived from its meaning-making context in which utterances are produced has been discussed in **Section 2.5.3.3** in the **Literature Review.** Hence, nine pragmatic categories of speech were used in the present study, derived from the literature on *speech acts* (Bruner, 1975; Searle, 1979)*,* particularly applied to private speech research (Feigenbaum, 1992; Furrow, 1984). It may be noted that, in order to code speech and behaviour independently from each other, the pragmatic content was decided on the basis of the intention of the speaker in creating a particular effect, rather than the actual effect that the utterance had on behaviour.

3.4.4 Developing a naturalistic and meaningful laboratory-based task

The limitations of observing children's speech and self-regulation in standard laboratory-based tasks have been discussed in **Section 2.4.2** of the **Literature Review.** In order to overcome the limitations of an artificial context in which children are usually expected to perform in a task, a novel sorting and organising task was developed in this study, which was embedded between two free-play sessions at the laboratory, and was designed to be meaningful to the children. The background narrative provided by the researcher for the children involved in the 'tidy-up' task, made the task appear to the children as a natural activity of tidying-up their play-area, by sorting and placing the toys that they were already playing with into appropriately-sized boxes, in order to start the next free-play session. Moreover, children's behaviour during the entire task was recorded and analysed for self-regulatory goal-directed behaviour and accompanying speech utterances. Thus the process of self-regulation was observed through the task, rather than simply its end product measured by the variable of task performance.

3.4.5 Analysing individual differences

The present study approached the issue of individual differences between children in their degree of verbal mediation of behaviour, from a quantitative as well as a qualitative aspect (refer to **Section 2.5.7** of the **Literature Review** for the necessity of examining the qualitative styles of private speech use in conjunction with behaviour). Due to the small sample size and exploratory nature of the study, group differences, rather than individual differences were investigated in the study. Hence recurring temporal patterns of co-occurrence of private speech and behaviour were extracted from the goal-oriented episodes of each child, for the two settings, namely the classroom and the laboratory. The children were initially divided into two groups on the basis of a measure of their frequency of unique temporal patterns involving speech and behaviour. Various pattern parameters obtained from the temporal patterns obtained for each setting were compared with other behavioural scores related to self-regulation (in the classroom and the laboratory) and task performance (in the laboratory), in order to investigate the quantitative aspects of group differences in verbal mediation of behaviour. Contextual analyses of the unique temporal patterns obtained for each group were then carried out, to examine the qualitative differences in the styles of verbal mediation of behaviour adopted by the two groups.

3.5 Research Design

This section describes the structure of the study and the various methods that were employed during the course of the study.

3.5.1 Overview

The present study was conducted in two phases of data collection - the first phase was conducted in naturalistic classroom settings and the second in a laboratory-based setting within a child-observation facility. For ease of reference, henceforth, the initial phase of the study based in schools will be referred to as *classroom phase* and the subsequent phase carried out in the observation facility will be referred to as *laboratory phase*. In the *classroom phase*, video recordings were conducted in two preschool classrooms in two different children's centres. During an initial acquaintance period before the recorded observations were conducted, the researcher spent time with the children in both the classrooms, in order to familiarise herself with the children and vice-versa. A group of children in each classroom was pre-selected for observation, based on their high scores in a teacher-administered instrument measuring self-regulation in young children. These

children were observed and recorded either individually or in groups as they went about their daily play-based activities in the classroom. In the *laboratory phase* of the study, a subset of children from the above-mentioned group completed a 'tidy-up' task either alone or in a dyad, in a child-observation laboratory at the Faculty of Education. The task was embedded within a play session that the children had been invited to participate in, at the observation laboratory.

The final number of participants whose recordings were analysed in the study comprised eight children selected from the two preschools. However, initially eight children had been selected from each preschool and hence recordings were made for all sixteen children in the *classroom phase*. The *laboratory phase* of the study took place over the summer vacations, when the study participants were able to come to the laboratory with their parents. However, some of those participants could not attend the laboratory session, as they were away during the vacations. Hence only twelve of the children, from the sixteen recorded in the preschools, participated in the *laboratory phase* of the study. In order to compare the performances of the children across both the settings, only those who participated in both phases of the study were finally selected. Of these twelve children, four of them did not yield suitable data from the classroom recordings made in the *classroom phase*. Hence for the purpose of this study, data from eight children were finally analysed and have been reported here.

3.5.2 Participants

The present study was exploratory in nature, since it aimed to investigate the phenomenon of temporal co-incidences between children's speech and their self-regulatory behaviour in goal-directed activities. Hence, in order to get rich data with several instances of the types of speech and behaviour under investigation, it was decided to preselect those children for the study who scored high on some measure of their self-regulatory behaviour. As the study also entailed detailed analyses of the speech produced by the children, only those children who spoke fluent English, preferably as their first language, could be selected for the study. Due to the inherent time limitations in a doctoral study, it was not possible for the researcher to select the children through observations of all the children in the two preschools. Hence the selection was carried out through the scores obtained from the teacher-administered Childrens' Independent Learning Development (CHILD 3-5) checklist (Whitebread et al. 2009). The CHILD 3-5 (a sample checklist is attached as **Appendix A**) is a observational assessment instrument designed for teachers to be used in classrooms as a measure of children's metacognitive and self-regulatory abilities in the 3-5 age

group. It consists of 22 statements against which a child is assessed on a four point Likert-type scale according to whether each is true of the child 'always', 'usually', 'sometimes' or 'never'. The statements in the instrument describe commonly observed behaviours which can be easily identified by teachers in various classrooms situations. The 22 statements fall under four broad domains of self-regulation, namely the emotional, prosocial, cognitive and the motivational domains, as identified by Bronson (2000). The instrument has been shown to reliably differentiate between children with high, intermediate and low self-regulatory abilities (Whitebread et al. 2009, Bryce & Whitebread, 2012).

Prior to data collection, the class teachers in each preschool administered the instrument for all the children in the class. The categories on the checklist for each statement were scored as follows: always = 4, usually = 3, sometimes = 2, never = 1. Starting from the top, children who obtained high scores through the instrument were selected for the study. Children who were assessed as highly self-regulating in the classroom were chosen to yield more instances of spontaneous self-regulation. This was essential, due to the exploratory nature of the person study, which depended on collecting several instances of potential speech and behaviour interaction. Hence eight children from Preschool 1 and eight children from Preschool 2 were chosen to be observed in the *classroom phase* of the study. In the *laboratory phase*, twelve of those children participated in the play-based laboratory session. Data from eight of those children were finally used for the purposes of this study. Of these, six of the children were from Preschool 1 (Male = 3, Female = 3), while two of them were from Preschool 2 (Male = 1, Female = 1).

The ages of the eight participants of the study at the time of observation during the *classroom phase* of the study ranged from 3.9 to 4.5 years (M = 4.2, S.D. = 0.18). During the *laboratory phase* of the study, the ages of the children ranged from 4.4 to 5.0 years (M = 4.7, S.D. = 0.2). Most children in the study were from White European backgrounds while one was from a Chinese background. None of the children displayed any explicit learning difficulties.

Classroom phase

The classroom phase of the study was conducted in the East Anglia Region of the United Kingdom, at two preschool nurseries, each running within an established Sure Start Children's Centre. Both the nurseries hosted a five-day-a-week, morning (9:00 am - 11:30 am) preschool programme for 3 to 4-year-old children. Due to this timing, the first 30 minutes at the beginning of the session, when the children arrived at the school with their parents and the last 30 minutes at the end of the session, when whole-class activities were carried out, were excluded from the observations. Hence approximately 60-70 minutes of video data were recorded each day.

Preschool 1

The first preschool had three classrooms; observations for the study were conducted in one of these classrooms. The classroom was led by the class teacher and two or three additional staff, namely the teaching assistants and the nursery nurse. The layout of the classroom consisted of several play and activity areas which the children were free to choose to play at, individually or in groups. These included separate areas for craft, drawing, painting, sand-pits, water-basin, pretend play, messy play, constructional play, puzzles and games, storytelling, computer activities, whiteboard activities, etc. They were also free to play in the common outdoor play area of the school. However due to the presence of children from other classrooms in the play area, high levels of noise and the highly unstructured movement of children while playing outside, observations for outdoor play were not carried out. Prior to the whole-class circle time at the end of the session, a 'tidy-up time' was initiated by the teacher with accompanying music, when the children cleaned the respective areas where they had last played during the morning session.

Preschool 2

The second preschool had a single large classroom with an open-plan layout. The classroom was jointly occupied by four groups of children, each led by a group teacher. The additional staff, namely the teaching assistants and school nurses were common to all the groups. The play and activity areas which were situated in different parts of the classroom included a painting area, a craft table, a whiteboard area with learning activities, a computer area, a exploratory play area with a sand-pit and a water-basin, a pretend play area, a puzzles and games area, a constructional play area and a story-reading area. The outdoor play area was also open for the children to use. Video

recordings were preferably made in the indoor classroom rather than the outdoor area, since the outdoor recordings picked up a considerable amount of external noise from the vehicular traffic plying on the adjacent road. Whole-group activities involving circle time, at the beginning and end of the session, were not recorded for the study. However the tidying-up periods, which took place just before the circle time, at the end of the session, were recorded.

Laboratory phase

The laboratory phase of the study was conducted in the child-observation laboratory set up at the Faculty of Education. The observation facility consisted of two rooms partitioned by a one-way mirror. The observation room was set up as a play-area, where the children were invited to play with the toys given to them and then asked to participate in a goal-directed ' tidy-up' task with the same toys that they were playing with. The room had been specially designed for the purpose of observing the activities of young children. It was fitted with 4 cameras, 3 of which could be remotely controlled for their pan, zoom and tilt functions, and were placed at the three corners of the room. Their position could also be changed vertically, such that they could be placed at a lower level for closely capturing the children's activities when they were sitting and playing on the floor. The fourth camera was fixed at the ceiling in the centre of the room for capturing a bird's-eye view of the activities taking place below. In-built microphones were fixed at several places in the room for getting a high quality of sound recording which was sensitive enough to capture the low-volumed private speech of the children. The recording equipment was suitably hidden from the children so that the environment created for them was as naturalistic as possible. The observation room was made sound-proof, so that the recording would not pick up any external noise.

The control room, on the other side of the one-way mirror, housed a computer, video monitors and other equipments for remotely controlling the cameras and the microphones. An assistant helped in the recording of the session while the researcher mostly stayed with the children in the observation room. The parents of the participating children were seated with the assistant in the control room and could observe the children either directly through the one-way mirror or through the video monitors.

3.5.4 Procedure

Acquaintance Period

In each preschool, the researcher went through an initial acquaintance period of 1 week prior to the main study, when she spent time with the children in the classroom and familiarised herself with the class layout and activities. As the children were used to frequent changes in the additional staff of the classroom, the researcher was also introduced to the children as being one of the supporting staff. This helped in establishing the presence of the researcher in the classroom as a familiar and collaborative adult for the children. During this period, after the first few days, the video camera and microphones that were to be used for the study were introduced by the researcher in the classroom. The children were familiar with the use of cameras by the teachers for recording the students' activities and their work and later showcasing them in the class bulletin board. Hence the presence of the video camera in the classroom was explained to the children as being used for recording their activities, in a manner similar to their teachers, as part of a project that the researcher was involved in.

Classroom phase

The first phase of the study involved recorded observations over a period of 5 weeks in Preschool 1 in the Spring Term (January to March 2012) and over a period of 6 weeks in Preschool 2 in the Summer Term (May to July 2012). A Sony-A1® digital video camera with a powerful zoom which could follow a child from a distance across the classroom, hand-held by the researcher, was used for video-recording. However a few activities were also recorded by placing the camera at a still position, while the researcher moved away from the camera and the children. Portable radio microphones which were synced with the video camera were used for recording the sound. These were placed suitably in the activity-area, close to the children being recorded.

The participant children were recorded either individually or in small groups of 2 to 4, while they were playing or working at a particular activity area within the classroom. Since the children in both the preschools engaged in self-selected activities, they were found to be consecutively involved in a range of activities during the day, such as free-play inside the classroom, structured activity organised by the teacher, outdoor play, snack breaks, etc. Since the focus of the study, as explained earlier, was on goal-directed behaviour during free-play specifically taking place inside the classroom, it was difficult to carry out structured observations, focusing on a single child per day. Hence the researcher chose specific occurrences of activities that any of the participating children

took part in, which could be recorded without unusually disturbing the children with the presence of the researcher and the video camera, while capturing all the details of the scene including the speech, facial expressions, hand gestures and immediate surroundings. The events selected for recording excluded those activities, which could not be feasibly recorded, such as a group of children constantly moving during their play, or a child playing in a corner of the room, facing the wall, such that her speech and actions could not be captured accurately. The recorded events ranged from under a minute to a maximum of sixteen minutes in duration. Hence the total duration of recorded video per child was variable. Relatively noise-free and visually clear recordings with meaningful activity which were suitable for further analysis were selected from the raw video data. Hence the total duration of the analysable dataset recorded from the *classroom phase* was 10 hours 39 minutes across both the schools, with a mean duration of 1 hour 20 minutes per child (S.D. = 27 minutes). The duration of individual episodes recorded for each child were highly variable, with a mean duration per episode at 3 minutes 20 seconds (S.D. = 3 minutes 18 seconds). **Table 3.1** below summarises the above-mentioned statistics, obtained from the classroom phase of the study.

The presence of the researcher while videotaping the activities was assumed to be non-intrusive, as evidenced by the regular comments or calls for assistance put to the researcher by the children, irrespective of whether they were being videotaped or not. This could be attributed to the collaborative nature of interaction between the researcher and the children.

Table 3.1 Durations of total analysable data collected in the classroom and the laboratory phase for all the 8 participants. Mean durations per episode of a child recorded in the classroom, and mean duration per child in the 'tidy'up' task in the laboratory are also mentioned, along with standard deviation (S.D.) values in brackets.

	duration variables	durations
Classroom phase	*Total analysable data*	10h 39m
	Mean duration per child (S.D.)	1h 20m (27m)
	Mean duration per episode (S.D.)	3m 20s (3m 18s)
Laboratory phase	*Total analysable duration of 'tidy-up' task*	27m 2s
	Mean duration per child (S.D.)	3m 22s (1m 0s)

Laboratory phase

The second phase of the study involved structured recording of children in the child-observation laboratory, individually or in dyads, as they were engaged in solving a goal-directed 'tidy-up' task. The controlled environment of the laboratory-based task provided an opportunity to predefine the goal of the task and maintain uniform settings in terms of the task-materials used. The only difference was that half of the children carried out the task alone, while the other half carried it out in pairs. This enabled a contrasting comparison between speech produced in a solitary condition versus speech produced in a dyad. Although the task was administered for an average of 10-15 min. depending upon the performance of the child/dyad involved, several parts of the task were not analysed in this study, wherein the researcher was directly talking to the child/dyad, to answer their query or provide assistance. Hence the total analysable duration of the 'tidy-up' task, combined for all the children was 27 minutes 2 seconds. The mean duration of the task analysed per child was 3 minutes 22 seconds (S.D. = 1 minute 0 seconds). These figures are also reported in **Table 3.1**, presented above.

In order to preserve the naturalistic atmosphere during the recorded session, the 'tidy-up' task was embedded between two play activities and fitted in a continuous and meaningful narrative, rather than presented as a separate task. In both conditions (solitary and group), the participants were initially given two trains and some train-tracks to play with and were shown two themed play sets (a farmhouse or a home), one of which they chose to play with, after having played with the train-tracks. The 'tidy-up' task was embedded between these two activities. After having played with the train-tracks for about 10 minutes, the researcher brought a box wherein all the train-track pieces could be placed, so that the themed play sets could be taken out next. However the box already had an assortment of Duplo[R] pieces in red, yellow and blue colours, which had to be removed to store the train-track pieces. The researcher would then point to a set of three boxes of increasing sizes, placed at a corner of the room, which could be used to store the Duplo[R] pieces. However the pieces had to be sorted by colour and stored separately in each box. The pieces had been chosen to just fit in their respective boxes, and thus required a certain degree of manipulation while placing the pieces in the box. The task was intentionally designed to appropriately challenge the participants. After indicating that they had managed to place all the pieces in the three boxes, the children could play with one of the two themed play sets that they had chosen earlier in the session. The researcher was present during most of the tidy-task task, and left the room for a certain

duration, so that the children were without any adult presence during that time. The researcher intervened in the beginning to explain the requirements of the task, and in the end when the children displayed frustration or disinterest in the task, when they could not complete it successfully.

3.6 Calculation of Inter-rater Reliability

Reliable inter-rater agreement was sought for all the speech and behaviour coding schemes which were developed and used in this study. Second-rater agreement was carried out for 10% of the total duration of the coded data from the classroom dataset. This corresponded to eleven randomly selected goal-oriented episodes, with a total duration of 13min 40s of coded data. Once reliable agreement was established for all the codes in the classroom dataset, the coding schemes were applied to the laboratory dataset. Two independent coders were involved in this process, who were naïve to the aim of examining the temporal interaction between speech and behaviour. To ensure further independence between the coding of speech and behaviour, each coder categorised only the speech utterances for half the videos, and behavioural events for the other half. This way, no episode was coded for its speech and behaviour by the same coder. However, some contextual codes were coded by the same coder for all of the selected episodes.

An initial practice session for the coders was conducted with the researcher for all the coding schemes, to ensure basic understanding of the phenomena being observed and clarify any confusion. A few codes which could not be agreed upon by the coders and the researcher consistently were adjusted as a result of this practice session. Inter-rater reliability (Cohen's Kappa) was then computed for the final versions of the all the coding schemes. The reliability scores achieved for each coding scheme are reported in the next chapter on **General Results**, which describes the development of the entire coding framework for this study.

3.7 Data Analysis

One of the principle aims of this study was to develop a suitable methodology for examining the real-time verbal mediation of behaviour. Hence, apart from using the standard statistical techniques that rely on the frequency of occurrence of various variables, 't-pattern analysis' (Magnusson, 2000) was employed as a data analysis tool to investigate the hidden patterned structures in a stream of goal-directed behaviour involving speech production. Hence this section describes the standard procedure of data analysis employed in this study, followed by a detailed description of the 't-pattern' algorithm, used in this study, for detecting temporally recurring patterns (termed as *t-*

patterns) of speech and behaviour. T-pattern analysis provides a way for conducting robust quantitative analysis of the data to detect statistically significant patterns of behaviour, free from any researcher's bias, which can then be subjected to in-depth qualitative analyses. Hence, the procedure followed to conduct a detailed contextual analysis of some of the t-patterns obtained during the data analysis are further described in this section. The particular ways in which these techniques are employed in the present study to analyse the data pertaining to each research question are described in the subsequent chapters.

3.7.1 Tests for normal distribution

Various speech and behavioural variables obtained from the eight children were used to examine the temporal relationship between them, both in the classroom and the laboratory settings. The distribution of these variables from the classroom and the laboratory setting were tested for normality using the *Shapiro-Wilk test,* due to its suitability for small sample sizes (N < 50). The results were not normal for several speech and behavioural variables which occurred rarely in the recorded data. (see **Appendix B)**. Hence non-parametric statistical procedures were applied for all analyses in the study.

3.7.2 Standard statistical analysis

Taking into consideration the deviation from normality for several variables collected in the data, non-parametric versions of the standard statistical tests were employed for all data analysis based on the frequency of the variables. Hence, correlations between speech and behaviour variables were computed using the *Spearman's rank-order correlation,* which is the nonparametric version of the Pearson product-moment correlation. Similarly, the *Wilcoxon signed-rank test* was used for making comparisons between the samples as a non-parametric alternative to the paired Student's t-test. Due to the varying duration of the goal-oriented episodes recorded per child in the study, raw frequency of occurrences for all the variables were converted into rates of occurrence per minute (RpM), before applying any statistical procedure.

3.7.3 T-pattern analysis

The '*t-pattern*' analysis employs an iterative pattern detection algorithm developed by Magnusson (1996, 2000), for identifying hidden temporal patterns within complex behavioural data. The algorithm has been operationalised in the software package called THEME[(R)] 5.0 (Noldus 2002),

which was used in the present study. Through this analysis, recurring sequences of behavioral events can be detected and examined. Hence, the t-pattern algorithm has been used in diverse areas of research such as - behavioural analysis of children and their interaction with caregivers, particularly for children with autism and ADHD (Masunami, Okazaki & Maekawa, 2009; Tardif *et al.*, 1995; Warreyn, Roeyers, Van Wetswinkel & De Groote, 2007), qualitative differences between children with SLI and typically developing children in their use of self-directed speech in mediating self-regulatory behaviour (Kuvalja *et al.,* 2014), temporal structure of behaviour in mental illnesses such as schizophrenia, mania and self-injurious behaviour (Kemp *et al.,* 2008; Lyon, Lyon & Magnusson, 1994; Lyon & Kemp, 2004); temporal analysis of sports performance (Borrie et al. 2002), human-animal and human-machine interaction (Kerepesi et al. 2006), and detecting patterns in rodent behaviour under various conditions (de Haas et al. 2011; Casarrubea et al. 2013).

3.7.3.1 Detecting hidden patterns

T-pattern analysis is based on the principle that any phenomenon with an underlying sequential structure will have its component events arranged in a particular temporal relation with each other and will occur together repeatedly in time. These events will hence form a temporal pattern, termed as a *t-pattern*. The time interval between consecutive events of a t-pattern will be relatively invariant, i.e. relative to the null hypothesis that each event in the data is randomly distributed over time and is independent of all other events in the data. However, the consecutive events in a t-pattern might not always be consecutive to each other in the actual data, and in most instances of naturalistic data, will contain random events termed as 'noise', in between the recurring events. It is the presence of such random noise events in between the recurring pattern of events in a stream of behaviour, that render the pattern invisible to any unaided inspection of the data. Such hidden patterns are also undetectable during standard statistical analyses. However, t-pattern analysis is able to detect such hidden patterns through its particular search algorithm.

3.7.3.2 T-pattern search algorithm

The t-pattern algorithm searches for a significant temporal relationship called the *critical interval (CI) relationship* between a pair of event types, forming the simplest possible temporal pattern or *t-pattern* in the form of a binary tree. If A & B form a recurring t-pattern, then after an occurrence of A at t, a *critical interval* $[t + d1, t + d2]$ $(d2 \geq d1 \geq 0)$ tends to contain at least one occurrence of B more often than would be expected by chance ($p < 0.005$). Bottom-up recursive searches starting from the simplest possible t-patterns lead to more complex and multi-level patterns, comprising of a

pattern of smaller t-patterns, all connected by the CI relationship. The recursive search continues until the longest possible t-pattern is detected with the largest number of event types. Hence a higher-order temporal pattern emerges from the data, which is not otherwise manifest in a complex stream of events. After all possible t-patterns are detected in the data, the second stage of the algorithm detects and deletes duplicate or incomplete versions of other detected patterns. This process is termed the competition for completeness and ensures that only the most complete patterns are finally detected.

3.7.3.3 Setting the search parameters

The t-pattern algorithm requires the setting of some search parameters by the user, before initiating a search, although optimal values are also suggested by the THEME$^{(R)}$ software itself. These parameters include, amongst others, *minimum occurrences* (minimum number of times a t-pattern must occur to be detected), *significance level* (maximum accepted probability of any critical interval relationship to occur by chance) and *minimum samples* (percent of samples or observations in which a pattern must occur to be detected). In order to set optimal values of the search parameters, suitable for one's research purpose, Magnusson (2000) suggests to carry out repeated analysis, starting with very rigorous values for the various parameters which may not yield many patterns, and then adjusting their levels until longer patterns are detected. Hence the researcher decides the final search parameters based on which patterns are meaningful and informative for the research question being addressed. The use of such artistry on the part of the researcher to set the values for various parameters (Kuvalja, *et al.,* 2014) has been pointed out as a limitation of this method, and the presence of further empirical work using this method has been suggested to guide the process of setting these values in the future (Winne, 2014). However, it may still not become an automated or standardised procedure, since determining if the t-patterns obtained through a set of search parameters are meaningful to the research context at hand can only be a subjective process. Albeit, such a subjective process can be made more transparent and systematic.

3.7.3.4 Pattern parameters

The patterns obtained as a result of the t-pattern search can be described on the basis of their different structural and frequency attributes as different pattern parameters. For example, the number of hierarchical levels in a pattern is termed *pattern level*, whereas the number of event types within a pattern determines its *pattern length*. Another parameter describing a pattern is its *pattern frequency*, defined as the number of instances of a particular pattern within an observed interval.

Fig. 3.1 (reproduced from Kuvalja *et al.,* 2014) illustrates a hierarchical t-pattern of three levels and a pattern length of five with three pattern occurrences within the observed interval T(0,t).
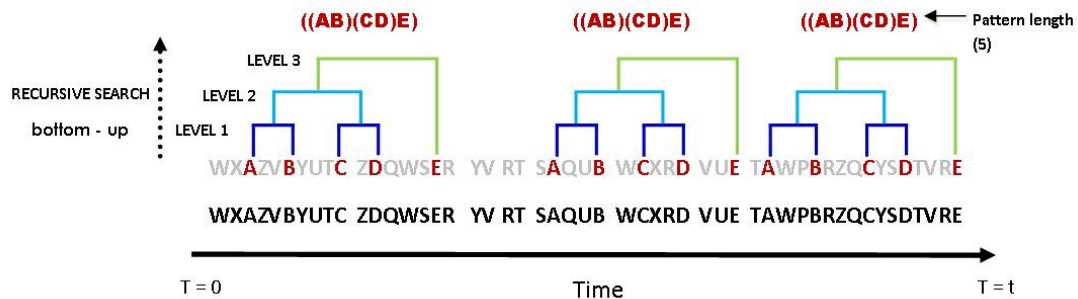
Figure 3.1 Three instances of a t-pattern detected by the bottom-up recursive search during an observed interval T(0,t) which consists of 50 events (black letters). Of these events, those which appear within the t-pattern are highlighted in red, whereas the events in grey are the 'noise events' in the observed interval, which are left out of the pattern. The *pattern level* is 3 since the pattern is composed of 3 hierarchical levels denoted by the expression : ((AB)(CD)E), comprising two lower-level t-patterns (AB) & (CD) followed by the event E. The *pattern length* is 5, since the pattern comprises 5 events. The *pattern frequency* is 3 since the pattern occurs thrice within the observed interval.

3.7.3.5 Selecting t-pattern for further analysis

The THEME [(R)] 5.0 software allows the quantitative or qualitative selection or arrangement of the detected t-patterns, based on their various pattern parameters or particular events within the patterns, respectively. This enables further analysis of the t-patterns, according to the research question. Hence, the t-patterns detected through a search cycle can be arranged in ascending or descending order of their *pattern length, pattern frequency, pattern level, % duration across the dataset,* etc. Similarly, sub-sets of t-patterns can be selected through combinations of logical operators (AND, OR, NOT, etc.) applied to t-patterns comprising specific events. These events can be specified in the software by the user. Hence, in the context of the present study which examined the verbal mediation of behaviour, only those t-patterns which comprised both speech and behaviour events were selected for further analysis.

3.7.3.6 Checking the validity of t-patterns

It may be possible that owing to the large number of events within a dataset, any search for a temporal relation between its events might reveal some t-patterns, simply by chance. Hence, in order to check for the validity of the t-patterns obtained above and beyond chance, comparison with t-patterns obtained after randomization of the original dataset has been suggested (Magnusson,

2000). Hence the original dataset can be randomized several times, while keeping the number and frequency of events unchanged, although arranged in a random temporal order. T-pattern searches may be initiated within both the datasets using the same search parameters. If many more patterns are found in the original data than in the randomised dataset, this may indicate that the t-patterns obtained in the original dataset are valid and unlikely to have been found by chance. This procedure was carried out for checking the t-patterns obtained in the classroom and laboratory datasets in the present study (refer to **Section 4.4** of the **General Results chapter**).

3.7.3.7 Meaning of a t-pattern

Another limitation of the bottom-up search algorithm is that the patterns thus obtained might not be meaningful from the theoretical, contextual, task and individual perspectives (Azevedo, 2014). However, as the creators of the algorithm have suggested, it is the context of the research question itself which provides meaning to a t-pattern (Casarrubea *et al.,* 2015). A t-pattern obtained from a dataset may be meaningless, unless the situation in which such a t-pattern occurred in the dataset is also examined. Hence, in the present study, simply the co-occurrence of task-relevant speech and goal-related behaviours within a t-pattern was not considered to represent meaningful verbal mediation of behaviour. In order to ascertain this, the t-patterns obtained from the analysed datasets were further analysed contextually in real-time, to reveal actual instances of verbal mediation of behaviour. This process is described in the next section.

3.7.4 Contextual analysis of t-patterns

The t-patterns comprising speech and behaviour, which were obtained in the present study, under various task conditions were then contextually analysed. The THEME [(R)] 5.0 software can provide a list of the timings of all the occurrences of a particular t-pattern within a dataset. Hence a t-pattern can be traced back to a particular instance of its occurrence in a dataset. This allows for a detailed analysis of the context in which the events of the t-pattern occur in real-time, along with other neighboring events, which might not have been picked up by the t-pattern search. In the present study, these events were first placed under the larger context of the goal-oriented episode in which the t-pattern occurred, as well as within the micro-situation in the episode, where the events took place. This was conducted by laying out the '*description of the context*' for a selected occurrence of a t-pattern. This was followed by listing out the '*transcript of events*' including both the events of the t-pattern as well as other neighbouring events, in the order in which they appeared in real-time.

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The last step involved the '*analysis of events*', where the content of the events and their meaningful relation with each other was charted out to reveal actual instances of verbal mediation of behaviour.

3.8 Ethical Considerations

As the study involved conducting research with human participants, especially children, all efforts were taken to conform to the ethical guidelines and code of conduct stipulated by the British Psychological Society and the British Educational Research Association. A departmental ethics committee approved the ethical standards followed in the study before its commencement. Informed consent of the participating children's parents was given prior to the observations. Enhanced disclosure from the Criminal Records Bureau had been obtained prior to any data collection. Issues such as the purpose of the study, procedures involved, confidentiality of data, anonymity of individual participants and the school and the right to withdraw at any stage were explicitly discussed in the consent form drafted for the parents. It was also agreed to use the observational data for the purpose of this study only, in order to maintain the privacy of all the children involved. Parental consent was sought for both phases of the study (*classroom phase* and *laboratory phase)* separately. For the *classroom phase*, parents of all the children present in the classroom were asked for permission to record their child's activities in the classroom, since many children who were not being observed in the study would also be present in the video recordings while playing and working alongside the participating children. For the *laboratory phase*, parents of those children who had been selected to participate in the study were requested to bring their child to the Faculty of Education, for a play-based session with another child from the same class, at the child-observation facility (parental consent forms for both phases are attached in **Appendix C).**

During both phases of the study, all precautions were taken to cause no harm to the participants. During the observation, care was taken to eliminate any potential risks to the psychological well-being of the children while causing least possible interference into their daily activities in the classroom. The preschool programmes involved in the study encouraged its teachers to use cameras (both still and video) within the classrooms for capturing the activities of the children as a method of visual record keeping. Hence the children did not perceive the video camera used by the researcher as a novelty or obstruction in the classroom.

Chapter 4. Results: General

4.1 Introduction

This chapter maps out the general results pertaining to all the research questions raised in this study. The subsequent three chapters discuss the results specific to each research question. The first part of this chapter describes the coding framework used in this study and the process by which the various components of the coding framework were developed, in accordance with the research aims of the study. The second part of the chapter describes the overall results obtained for all the speech and behaviour metrics recorded in the study. In the last section of the chapter, the t-patterns obtained in this study were verified to be unlikely to have been obtained by chance. This was carried out through a method of randomisation, advocated by the developers of the t-pattern algorithm.

4.2 Development of the coding framework

The coding framework used in this study was developed from a combination of codes adapted from previous studies, as well as those modified or created to suit the needs of the current study. Hence it is important to explain the process through which the framework developed into its final form. The first section lays out the broad classifications used in this study, and proceeds to tabulate the individual codes within each category, accompanied by their detailed description and examples observed in the study. The next section explains the issues that arose during the coding process as well as after it, due to which, various decisions were taken to shape the coding framework in its final form. The framework was in most parts commonly applied to data collected from both phases of the study, i.e. the recordings of the classroom activities as well as the laboratory-based task. Hence, apart from the specific instances where certain categories and codes were only used for the classroom or the laboratory data, the coding framework will be commonly discussed for both.

4.2.1 Contextual and behavioural categories

The coding framework used in this study comprised categories of two kinds - *contextual* and *behavioural* categories. Contextual categories mapped out the context of an episode, while behavioural categories recorded individual instances of verbal and non-verbal behaviour in an analysed episode which were relevant to the aims of the study. These categories were represented by two types of events, namely, *state events* and *point events,* respectively. State events are those events which represent continuous behaviours occurring over a period of time, and hence have a

distinct start and end, and are of a specific duration. Point events, on the other hand, capture discrete behaviours occurring at a particular point in time, and hence do not have any duration.

4.2.1.1 Contextual categories

In the current study, three contextual categories, namely, *degree of goal-orientation, adult involvement* and *goal-sharing context,* were coded using state events to map the duration for which such contexts were applicable to the episode under observation. **Table 4.1** below tabulates the individual codes compiled under each of these contextual categories, along with their description and examples observed in the recorded data. Where certain codes were recorded only in the laboratory-based task, they have been marked as 'lab only'. Examples provided in the table are common to both contexts, namely the classroom and the laboratory, except when examples from the laboratory were needed to describe a scenario that may be unique to the laboratory-based task.

For the purpose of further analyses, only those portions of the data which were common to the state events: '*goal-oriented episodes'* and *'adult uninvolved'* (and *'adult absent'* in the laboratory-based task) were selected. All behavioural categories recorded as discrete events were coded within the above-mentioned selected portions of the data only. Each *goal-oriented episode* was classified either as an *I_goal* or a *we_goal,* and was used later as independent variable to divide the data into I_goal episodes and we_goal episodes, respectively.

Table 4.1. Contextual categories used in the present study, with description and examples, all coded as continuous state events, occurring over a certain duration of time.

Category	Description	Example
(A) Degree of goal-orientation:		
i) child absent	Default category of the focal child not being present in the episode - either because the child had not yet entered the scene or had left it.	*<Child left the play-area to talk to the teacher>*
ii) wandering behaviour	Behaviour with no apparent purpose or active engagement - e.g., wandering behaviour with no clear destination, passive bystander in an activity, etc. Following conditions satisfy the presence of such behaviour in the focal child: i) *No content* - engaged in no definable activity apparent to the observer, such that if the child was to be asked "what are you doing", the answer would be "nothing" ii) *Passivity* - not actively engaged or participating in anything, nor showing an intent to get involved in the near future iii) *No goal orientation* - behaviour does not seem to be aimed at any current or future goal	*< Child moving aimlessly between different play-areas>* *<Child passively observing the activity of a group of children involved in a game>*
iii) focused activity	Behaviour with a higher level of engagement with the surroundings in comparison to *wandering behaviour*. Following conditions satisfy the presence of such behaviour in the focal child: i) *Definable content* - engaged in a definable activity apparent to the observer, such that if the child was to be asked "what are you doing", the answer would be "I'm doing x" ii) *Active engagement* - actively engaged in an activity. E.g., taking part in a conversation or attending to it actively, in order to respond to it through words or actions would be classified as 'focused activity' iii) *No goal orientation* - no definable goal apparent to the observer or declared by the child, towards which the activity is directed; activity is being carried out for its own sake, and not as a means to achieving a distinct end	*<Child engaged in playing with the sand in the sand-table, filling up a large flat biscuit tin, but not following any particular script or pretence scenario with the prop used>* *<Child listening to the conversation between two children about their play plans, and later intervenes to propose a new game>*

Table 4.1. Contextual categories used in the present study, with description and examples, all coded as continuous state events, occurring over a certain duration of time.

Category	Description	Example
iv) goal-oriented episode	Observable or declared goal-orientation present in the child's behaviour. Following conditions satisfy the presence of such behaviour in the focal child: i) *Distinct goal orientation*- Behaviour seems to be oriented towards a goal that is separate from the activity itself. Hence if the child was asked "why are you doing this", the answer would be "I am doing this because of reason x", where the reason x is not simply a desired internal state of the child, but a concrete goal which can be apparent to the observer at any point in time, and is an anticipated outcome towards which behaviour can be regulated consciously. ii) *Pre-defined goal* - The goal is apparent to the observer much before it is achieved, and is clearly pre-defined either by the child herself or easily recognisable from the context. iii) *Anticipated goal* - The goal has been anticipated by the child, such that the child attempts to direct her behaviour to match the outcome of her actions with the anticipated goal through clear monitoring and control processes	*<Child is filling a large flat biscuit tin and pretends to 'hide some treasure in the treasure box' by placing some trinkets inside the box with the sand>* *<Child is looking for a suitable prop to use and get included in an on-going game of 'going on a picnic', where other children are finding props to put inside a 'picnic basket'>* *<Tidying up the craft table by putting back all the materials and stationary lying on the table into the designated slots and boxes placed in a nearby shelf>*
(B) Adult involvement:		
i) Adult involved	Situation when an adult was present in the close proximity of the child and regulating or participating in the on-going activity with or without any interaction with the child. An unobtrusive or onlooking presence of the adult, to which the child was not aware was not coded as 'involved', unless behavioural cues from the child indicated the awareness of the adult's presence. Any interaction with the researcher was coded as 'involved'.	*<Teacher directing the children to tidy up the craft table>* *<Lab: Child showing the researcher the box that she has filled with bricks>*
ii) Adult uninvolved	Situation when an adult was not present in the close proximity of the child in the classroom or maintained an unobtrusive or onlooking presence, to which the child was not aware. In the laboratory, the situation when the researcher withdrew from the on-going task of the child/dyad after giving instructions or helping out to overcome an obstacle, and then announced that she would be 'doing some important work' at the table on the side in the same room. The researcher's back was turned to the child/dyad to prevent any interaction. Situation was coded from the moment the child/dyad resumed their activity without indicating the intent to interact with the researcher any further.	*< Children tidying up the craft table after the teacher had left the craft area>* *<Lab: Researcher filling a form at a table on the side of the lab, while the dyad continued to fill the boxes with the Duplo bricks on the carpet in the same room >*
iii) Adult absent (lab only)	Situation (in the lab only) when the researcher left the observational room, on the pretext of taking a phone call, or getting some more toys to play with, etc., thus leaving the child/dyad alone.	*<Lab: Researcher left the room in the lab on the pretext of taking a phone call>*

Table 4.1. Contextual categories used in the present study, with description and examples, all coded as continuous state events, occurring over a certain duration of time.

Category	Description	Example
(C) Goal-sharing context:		
i) I_goal	A *goal-oriented episode* driven by a personal goal initiated by the child, not shared by others around, and the child was engaged in attaining that goal through individual effort only. In the laboratory-based task, all activities involving a dyad were not automatically coded as we_goals, but as I_goals if the children had divided the task between themselves and were engaged in solving their part on their own.	*< Child involved in fixing the door of a wooden toy house >* *<Lab: Child 1 (in the dyad) was engaged in filling up the largest box with Duplo bricks, while Child 2 was engaged in closing the lid of the smallest box >*
ii) we_goal	A *goal-oriented episode* driven by a shared goal initiated by the child or by other member/s of the group, but once set, the goal was shared by other members of the group (2 or more children) who were jointly engaged in attaining that goal. In the laboratory-based task, those activities involving a dyad were coded as we_goals if they were jointly carried out by both the children.	*< Child involved in fixing the door of a wooden toy house along with a classmate >* *<Lab: Child 1 & 2 jointly filling up all the boxes first by putting in the Duplo bricks of the appropriate colour in each box>*

4.2.1.2 Inter-rater reliability for contextual categories

Inter-rater reliability (Cohen's Kappa) for the coding of final versions of all three contextual categories was as follows:

• .90 for coding **degree of goal-orientation** as one of the 4 subcategories during classroom phase,

• .90 for coding **adult-involvement** as one of the 2 subcategories during the classroom phase,

• .79 for coding **goal-sharing context** as one of the 2 subcategories during classroom phase.

Landis and Koch (1977) characterised Cohen's Kappa values .61-.81 as 'substantial' agreement, and .81-1.00 as 'almost perfect' agreement.

4.2.1.3 Behavioural categories

Behavioural categories recorded the verbal and non-verbal behaviour of the participants, namely their goal-related behaviours (comprising *goal-directed behaviours, goal-mapping behaviours* and *goal-relevant events*) and speech utterances (comprising *pragmatic content, relevance to task* and *directed & adapted to*) using point events. Since these were discrete events, only their starting points could be recorded. Hence speech utterances were coded at the onset of their verbalisation. The starting points of goal-related behaviours were decided on the basis of behavioural cues such as

eye gaze, body movements, point of impact of an external event on the focal child etc., signifying, in most cases, the beginning of the intent for the expressed behaviour. **Table 4.2** tabulates the individual codes compiled under each of the three categories of goal-related behaviours, with their description and examples observed in the recorded data.

Table 4.2. Behavioural categories recording various types of goal-related behaviours, with description and examples, all coded as discrete point events.

Category	Description	Example
(A) Goal-directed behaviours:		
i) routine strategy	A strategy used intentionally to achieve the goal, it is routine in the sense that it is the ideal/standard strategy that may be commonly applied at the beginning of the activity, repeated instances of the same strategy are also marked as 'routine strategy', strategy can be used at the beginning of the activity and may involve planning functions such as resource collection, etc. or it may be a strategy used in the middle of the activity	*<place a large wooden block of appropriate size on the floor to start making a tower>* *<Pick up the 'oven gloves' to initiate the script of 'baking things in the oven'>*
ii) change strategy	Changing a previously used strategy to a new one, usually after noticing an error or goal-relevant issue, or facing failure through a previous strategy ,the change may even be an additional effort put in the same strategy, visibly increasing the pace of the previous strategy, or paying more focused attention in a previous strategy	*<stop closing the puzzle lid and instead pick up a piece of the puzzle left on the floor, noticed earlier>* *<increase one's pace of digging the sand and putting it in the box>*
iii) search strategy	A goal-oriented search for an object or an appropriate place required to attain the goal	*<Search for a suitable prop>* *<Search for a missing block>* *<Search for an appropriate place to put back the object>*
iv) regulate others	Directing or preventing the behaviour of another child in order to attain the goal	*<Stop another child from taking the prop being used in the game>* *<Showing the other child where to examine the 'dog' in a game of 'at the vets'>*
v) seek help	Asking an adult or more able peer for a specific help in attaining the immediate goal, after having attempted but failed to attain the goal or after correctly assessing one's inability to attain the goal.	*<Ask another child to take out the object stuck in a vase, after failing to take it out himself>* *<Seek teacher's intervention in resolving a conflict when it goes out of hand>*

Category	Description	Example
vi) check progress	Intentionally check for any issues or error or general progress of the task towards the desired goal; behavioural indicators of checking involve intentional eye-gaze, body movements or pause during the activity to inspect a goal-relevant issue; monitoring behaviour initiated through 'top-down' attentional processes	*<comparing with a '4' written on the board, to check if writing a '4' correctly on the paper>* *<bend down to check if there is excess cloth at the bottom of the table, with the goal of placing the table-cloth on the table symmetrically>*
vii) notice error/ issue	A goal-relevant issue becomes salient and is noticed by the child, the child may not be necessarily looking for that error or issue, monitoring behaviour displayed through 'bottom-up' attentional processes	*< while putting some pieces of a game in a slot, notice a differently shaped piece which does not belong to the game>* *<notice another door-panel lying on the floor of the wooden play-house, while fixing the panel already in her hand>*
viii) repeat failed strategy	Carrying out the same strategy without any change, even after having met with a failure when using the same strategy previously	*<repeat the dragging of an object on the computer screen using a mouse which is in a tilted orientation, without straightening the mouse's orientation>* *<try to take out a muffin-shaped toy from a muffin-case using only one hand, as tried previously without success>*
(B) Goal-mapping behaviours:		
i) new goal pursuit	Beginning of the conceptualisation of the goal, not the actual goal-directed strategy that may follow soon after	*<Curl the 'customer's' hair with the hair-roller, in a game of 'at the hairdressers'>* *<Place some 'dinosaurs' inside the enclosed 'dinosaur shelter' just built>*
ii) return to previous goal	Return to a previously initiated goal, after a brief 'distraction' or a longer period of 'leaving goal pursuit'	*<Return to making her craftwork, after being distracted by the teacher talking to other children nearby>* *<Return to filling the box with sand, after the sand spilled out of the box>*

Category	Description	Example
iii) leave goal pursuit	The overt and deliberate leaving of goal pursuit (due to failure or disinterest) rather than a chance distraction from the goal or termination of the activity	*<leave the play-area, and not make further attempts to be included in the on-going game>* *<stop further attempts to retrieve the fallen basket of cups and saucers, which was to be used as a prop>*
iv) focused activity	event marking the beginning of the contextual state event: *focused activity.* *(A discrete event marking the start of this state event was required within a goal-oriented episode, since the state event focused activity itself was not further analysed in the study)*	*<leave the pretend scenario of 'baking' and show another child how to use the 'oven gloves'>*
v) wandering behaviour	event marking the beginning of the contextual state event: *wandering behaviour* *(A discrete event marking the start of this state event was required within a goal-oriented episode, since the state event wandering behaviour itself was not further analysed in the study)*	*<leave the play-area and start to look aimlessly at the activity of some classmates playing nearby>*
(C) Goal-relevant events:		
i) distraction	Any object, person or event in the environment of the child which manages to distract the child from his on-going activity, marked by a pause in activity, or a gaze towards the source of distraction	*<Looking at children talking nearby>* *<Looking at teacher saying something to another child>*
ii) disruption	*Disruption* is more intrusive than a *distraction*; any object, person or event in the environment or in the activity itself which directly, physically disrupts the activity of the child, or any accident during the activity with the materials and resources involved that causes disruption	*<The drawing paper slips from the hand and falls down>* *<Another child interrupts to invite to join another game>* *<The straw bends while attaching it to the model>*
iii) failed strategy	Goal-directed strategy used previously which failed to achieve the desired effect or the ultimate goal	*<Not able to use the prop as intended>* *<Not able to get the desired toy from another child>* *<Unable to find a suitable position to place a wooden block on the tower>*

Table 4.2. Behavioural categories recording various types of goal-related behaviours, with description and examples, all coded as discrete point events.

Category	Description	Example
iv) regulated by other	Another child prevents the behaviour of the child in the pursuit of her goal	*<Another child prevents from using a prop>* *<A plan rejected by another child>*
v) facilitative event	Any external event or person that may aid or enhance the pursuit of the goal	*<Another child adds further to the joint model being built>* *<Another child hands over a prop to include in the game>*
vi) goal attained	A successful attempt at pursuing and achieving the goal, not just the ending of an activity	*<appropriate place found for the odd piece of the board-game>* *<included in the game of 'at the tea-party'>*
vii) failure to at-tain goal	An actual failed attempt at pursuing the final goal, not just the absence of any successful event	*<not able to put the 'treasure' (a heavy sand-filled box) on the 'pirate ship' (a chair)>* *<could not put the hair-roller on the 'customer's' hair, during a game of 'at the hairdressers'>*

All speech utterances in the study were classified on the basis of three separate dimensions, namely, *pragmatic content, relevance to task* and *directed & adapted to*. **Table 4.3** tabulates the individual speech codes compiled under each of these three dimensions of speech. The nine categories under *pragmatic content,* comprise 29 separate speech codes merged together. The individual descriptions of these 29 codes, with examples observed in the recorded data are provided in **Appendix D**. All utterances were first coded according to their content using these 29 mutually exclusive and exhaustive codes. Of these seven codes were specific to the pretence framework, and were placed under the category of *pretence speech,* while the remaining 22 codes were applicable to the general non-pretence context, and were placed under the category of *context-related speech.* In order to increase the strength of all further speech analyses, the 29 codes were combined into the nine *pragmatic speech categories.* These merged categories were created on the basis of what the speaker broadly intended during the production of the various speech codes, and hence focused on the pragmatic content of the utterances.

Table 4.3 The three dimensions of speech utterances - *pragmatic content, relevance to task* and *directed & adapted to,* under behavioural categories, all coded as discrete point events

Category	Description	Example
(A) Pragmatic content:		
i) directive	Speech utterances aimed at <u>directing the listener</u> (and even the speaker himself) to do a certain action, either directly or indirectly.	• *directing/ stating a rule* • *proposing a plan* • *instrumental* • *prompting* • *implicit pretend structuring* • *explicit proposal*
ii) informative	Speech utterances aimed at <u>informing the listener</u> about an object, situation, issue, occurring in the past, present or future, does not necessarily require an immediate action or response from the listener, unlike *directive speech*.	• *describing one's actions* • *referential* • *enactment* • *ulterior conversation* • *underscoring* • *storytelling* • *non-present speech* • *attentional*
iii) evaluative	Speech utterances aimed at <u>providing an assessment</u> of the situation, usually through cognitive evaluation, logical reasoning or metacognitive insight.	• *evaluative* • *consequential/ if-then* • *metacognitive self-knowledge*
iv) emotive	Speech utterances aimed at <u>expressing emotional content</u> and releasing the speaker's experienced emotions through verbalisations	• *expressive* • *laughing/ crying/ screaming*
v) seek/respond	Speech utterances aimed at <u>resolving a query</u>, either by posing a question to seek some unknown information or answering the query, in order to resolve it.	• *seek information* • *response*
vi) agree/dis-agree	Speech utterances aimed at <u>expressing the speaker's agreement or disagreement</u> in a situation	• *agreement* • *disagreement*
vii) repetitive	Speech utterances aimed at <u>repeating a previous utterance</u>, usually accompanied by a change of volume or tone	• *repeating oneself* • *repeating other*
viii) indistinct	Speech utterances not aimed at clear social communication, usually marked by abbreviated, codified language use, in a lowered volume or involving lip movements or mutterings	• *unclear/ unrecordable* • *muted speech/ mumbling*
ix) other	Speech utterances aimed at fulfilling a range of actions achieved through speech such as maintaining verbal continuity between transitions, accompanying one's actions with songs or non-word utterances, etc.	• *transitional* • *singing/ humming/ word play*

Table 4.3 The three dimensions of speech utterances - *pragmatic content, relevance to task* and *directed & adapted to,* under behavioural categories, all coded as discrete point events

Category	Description	Example
(B) Relevance to task:		
i) task-relevant	Utterance is directly related to completing the task, referring to task-related objects/people/ events ; Utterance which is unclear in its content (unrecordable or mumbling speech) or in its meaning (relation to task is unclear)	*"Hey, I want a spoon"* *"We don't need that one"* *"We're doing a good job"* *"Give me that"* *"We should put dolly in the bath"* *"I'm […]"; "No, fa da tah"; "Why, I always [..]"*
ii) task-irrelevant	Utterances is not related to completing the task, referring to task-unrelated objects/people/events	*"Why is she crying?" <referring to a child crying nearby>* *"Look what I've got!" (<referring to an object unrelated to the task>* *"I'm going to a picnic tomorrow"* *"La la lala" <humming a tune>*
(C) Directed & adapted to:		
i) social speech	Speech utterance in which eye contact occurred anytime during an utterance's expression or in the preceding or following 1 second; speech utterance in which no eye contact occurred during an utterance or in the preceding or following 1 sec, but other social indicators did, such as: **a) Paralinguistic indicators:** Interaction between speaker & listener through touch, pointing, gaze or any other physical gesture within 1 second of the utterance **b) Linguistic indicators:** Conversational turn-taking, Q/A directed to other, another person's name, personal pronoun	*"Give it to me…give it to me"* *"Let's have a picnic"*
ii) private speech	Any verbalization by the child, which did not contain one of these social markers, including inaudible muttering and silent verbal lip movements; a seemingly social utterance according to the above objective criteria for social speech, but whose content is not adapted for the listener, such that it has a private meaning for the speaker	*"Who it be, it might be"*

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A hypothetical example in **Fig. 4.1** shows a visual timeline of an episode where the contextual categories - *degree of goal-orientation* and *adult involvement* are marked as continuous state events. Note that the codes within this type of category were coded as a mutually-exclusive and continuous group, wherein the start of one state behaviour marked the end of a previous behaviour from the same category, and one state behaviour from the category was always active. The codes within the contextual category *goal-sharing context* are used to qualify each *goal-oriented episode* as an *I_goal episode* or a *we_goal episode*. The codes pertaining to goal-related behaviour and speech utterances within the behavioural categories are marked as discrete point events. All behavioural categories are recorded within the intersection of the two contextual state events : *goal-oriented episodes* and *adult uninvolved,* shown in the figure as the shaded area marked 'analysed episode'.
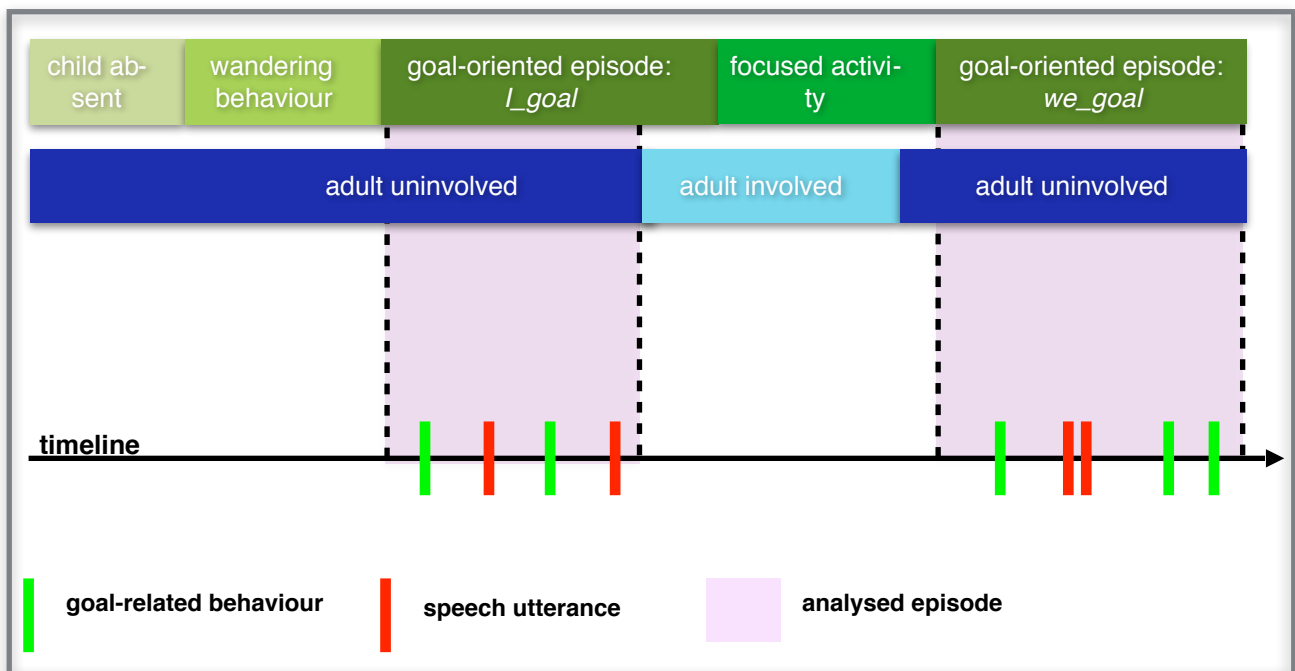
Figure 4.1 Visual timeline of an episode with the codes within the contextual categories recorded as continuous state events, and the speech and behaviour codes within the behavioural categories recorded as discrete point events. Behavioural categories are coded only within the shaded area marked 'analysed episode': the intersection of goal-oriented episode and adult uninvolved.

4.2.1.4 Inter-rater reliability for behavioural categories

Inter-rater reliability (Cohen's Kappa) for the coding of final versions of all behavioural categories was as follows:

- .79 for coding **goal-directed behaviours** as one of the 8 subcategories during classroom phase,

- .90 for coding **goal-mapping behaviours** as one of the 5 subcategories during classroom phase,

- .83 for coding **goal-relevant events** as one of the 7 subcategories during classroom phase,

- .77 for coding **pragmatic content of speech** as one of the 9 subcategories during classroom phase,

- .90 for coding **task-relevance of speech** as one of the 2 subcategories during classroom phase.

- .79 for coding **directed to/adapted for speech** as one of the 2 subcategories during classroom phase,

Landis and Koch (1977) characterised Cohen's Kappa values .61-.81 as 'substantial' agreement, and .81-1.00 as 'almost perfect' agreement.

4.2.2 Issues addressed by the coding framework

The coding framework described above was developed in accordance with some of the methodological and theoretical aims of the study. On the other hand, it also needed to address the challenges of analysing naturalistic data. The issues that arose in the study in this regard, and how they were addressed by the coding framework, are discussed below.

4.2.2.1 Mapping the process of self-regulation

With the broad aim of examining the role of speech in the self-regulation of behaviour in real-time, it was clear that variables such as overall task difficulty or task performance could not be employed in the study, since they stood for the end product of self-regulation, or based on the assumption that self-regulation was employed in a difficult task, rather than the actual process of self-regulation. Hence if the real-time temporal relationship between speech and self-regulatory behaviour needed to be examined, then a coding scheme that could capture the process of self-regulation during an activity was required, especially while observing young children. In recent years, assessment of self-regulation in young children through observational methods in a naturalistic setting has emerged as a key tool that proposes to overcome the limitations posed by other methods such as verbal self-reports and think-aloud measure (refer to **Section 2.4** in the **Literature Review** for a discussion on the various issues concerning assessment of self-regulation in young children). Hence coding frameworks which directly observe self-regulatory processes in young children were adapted for the study (Pintrich, 2000; Whitebread et al, 2009). The above-mentioned coding frameworks also included separate codes for the various cyclical phases of self-regulation, namely

planning, *control*, *monitoring* and *evaluation* of the task at hand (refer to **Section 2.2.1** in the **Literature Review** for a discussion on the various theoretical models of self-regulation including their domains and phases of operation). However, one of the aims of the study (discussed in **Section 4.2.2.4** below) was to carry out independent observation of speech and behaviour. The coding framework devised by Whitebread *et al*., (2009), however, employed both verbalisations and behaviours in identifying the various phases of self-regulation expressed by young children. Hence for the purpose of this study, the codes had to be modified such that they only used behavioural cues to represent different phases of self-regulation. As a result, the planning phase had to be merged into the control phase, and comprised all task-related strategies carried out to complete the task (i.e. *routine strategy, change strategy, search strategy, regulate others* and *seek help*). These included strategies implemented at the beginning of the task in the form of planning, or as changes made during the task in the form of control processes, since it was difficult to differentiate between them, based on behavioural cues alone. For the same reason, the evaluation phase had to be merged into the monitoring phase, and comprised all behaviours indicating the supervision and assessment of task progress and accuracy (i.e. *check progress, notice error/ issue*). These included supervisory behaviours expressed during the task in the form of monitoring, or at the end of the task in the form of evaluation. In addition to successful occurrences of self-regulatory behaviour, the study also recorded instances of failures of self-regulation, represented by the code - *repeat failed strategy*. It may be noted that the code - *regulate others,* represented a task-related strategy but involved regulating another child towards completing the task, and hence was also included as a control strategy. All of the codes hence derived were placed under the category of *goal-directed behaviours*. **Fig. 4.2** below, tabulates the codes under this category of behaviours, along with the different phases of self-regulation that they belonged to.

Goal-directed behaviours
• *routine strategy* - CONTROL
• *change strategy* - CONTROL
• *search strategy* - CONTROL
• *regulate others* - CONTROL
• *seek help* - CONTROL
• *check progress* - MONITORING
• *notice error/issue* MONITORING
• *repeat failed strategy* - FAILURE

Figure 4.2 Individual codes compiled under the behavioural category of *goal-directed behaviours*, along with the phase of self-regulation to which they belong.

4.2.2.2 Observing self-regulation within goal-oriented episodes

Regulation of one's behaviour can occur at various levels of complexity within any activity that one is engaged in, since we are constantly engaged in controlling and monitoring the actions that we perform. Hence, verbal mediation of behaviour can take place at any level of complexity. Within a naturally occurring activity in a preschool classroom where children are engaged in continuously changing and open-ended tasks, instances of self-regulation can be searched throughout the activity. Hence in order to restrict such a broad definition of self-regulation to its operation at the highest level of complexity, it was decided to examine a child's self-regulatory behaviour during clearly identifiable goal-directed episodes within the child's activity. Hence, firstly a spectrum of behaviours were identified within the recorded activities, graded according to their degree of orientation towards a goal, ranging from no apparent purposeful behaviour to a clearly goal-oriented behaviour with an anticipated and pre-defined goal. These codes were mutually exclusive and exhaustive, and covered the entire recorded activity of a child, namely, *child absent, wandering behaviour, focused activity* and *goal-oriented episode,* and placed under the category of *degree of goal-orientation.* **Fig. 4.3** below, tabulates the codes under this contextual category.

Figure 4.3 Individual codes compiled under the contextual category of *degree of goal-orientation*

All further analyses dealt with the final category in the spectrum of behaviour, i.e., *goal-oriented episode.* The goal of such an episode was identified from the perspective of the focal child, and the codes pertaining to the various phases of self-regulation discussed in the previous section such as *control* and *monitoring* were defined according to the goal towards which behaviour was oriented. Hence control strategies were those strategies which were employed by the child to achieve the goal (i.e. *routine strategy, change strategy, search strategy, regulate others* and *seek help)*, while monitoring strategies were those strategies which monitored one's progress towards the goal, and noticed any issues or errors that could restrict or prevent the attainment of the goal (i.e. *check progress* and *notice error/issue*). Repetition of a strategy which had failed to achieve the goal in an earlier attempt was identified as a failure of self-regulation (i.e. *repeat failed strategy*). Such a coding scheme based on goal-orientation also made it possible to map the myriad of events occurring within children's daily classroom activities to a common coding scheme, wherein no two activities were the same in their content.

4.2.2.3 Separating the dimensions of speech

In the private speech literature, speech, and in particular private speech, has been coded based on various dimensions such as form (e.g., overtness, degree of abbreviation), content (e.g., relevance to task, semantic content), function (e.g., self-regulation, communication), etc. The literature also reveals coding schemes where these varying dimensions have been confused for a single construct and put together in a single set of categories (refer to **Section 2.5.3.4** in the **Literature Review** for a discussion on this confusion of form, content and function). Each of these dimensions have their own merits in addressing a particular research question, but their role in answering a particular

question and their inability to answer other questions should be made very clear at the beginning of any study. Hence one of the aims of the study was to avoid such confusion and clearly identify the different dimensions, on the basis of which, speech was categorised in this study. Hence precaution was taken while constructing the coding framework to not attribute *a priori* functions to speech categories, based on their content or form, since one of the aims of the study was to derive the function of speech based on its temporal relation with behaviour. In this study, speech was categorised on the basis of three dimensions, namely *pragmatic content*, *relevance to task* and *directed & adapted to,* which are explained below.

a) *Pragmatic content*

All utterances were first coded according to their content using 29 mutually exclusive and exhaustive codes. Of these, seven codes were specific to the pretence framework, and were placed under the category of *pretence speech*, and were applied to any utterance which referred to objects, persons, and situations that were imaginary or were being pretended to exist by the child. These seven codes were based on the continuum of meta-communication utterances in make-believe play, developed by Giffin (1982). **Fig. 4.4** below, tabulates these codes under the category of *pretence speech*.

Speech: Pretence speech
• *enactment*
• *ulterior conversation*
• *underscoring*
• *storytelling*
• *prompting*
• *implicit pretend structuring*
• *explicit proposal*

Figure 4.4 Individual speech codes compiled under the category of *pretence speech*

For the remaining 22 codes, the basis of categorisation was not merely the semantic content of the utterance, but 'what was meant' by the speaker in the given situation (see **Section 2.4.3.3** for a detailed discussion). This was inspired by the pragmatic approach to language advocated by Bruner

(1975), who used the concept of *speech acts* in categorising utterances based on the 'use' of language in a given context rather than its structural/syntactical form. Hence, the codes used in this study differed at several places from previous coding schemes in the private speech literature which have used semantic content as the basis of categorisation (Copeland, 1979; Diaz et al, 1992; Winsler, 1998; Winsler *et al.,* 2003). For example, many utterances produced in the question form, such as, *"Can I have a go now?"*, were not coded as a *question* but rather as an *instrumental statement,* referring to the child's desire to have her turn in the game. Only those utterances in the question form which sought a discrete piece of information hitherto unknown to the speaker were coded as *seek information.* Due to the same reason of giving preference to meaning over form, gestures with a clear communicative meaning were coded according to their meaning and use, as one of the codes in this category, instead of being named as a separate code. The 22 codes used in this study were more similar to the coding scheme used by Furrow (1984), which were in turn based on Bruner's (1975) categorisation. These codes were placed under the category of *context-based speech*. **Fig. 4.5** below, tabulates the 22 codes under the category of *context-based speech*.

Speech: Context-based speech	
• **directing/ stating a rule**	• **seek information**
• **proposing a plan**	• **response**
• **instrumental**	• **agreement**
• **attentional**	• **disagreement**
• **describing one's actions**	• **repeating oneself**
• **referential**	• **repeating other**
• **evaluative**	• **singing/ humming/ word play**
• **consequential/ if-then**	• **transitional**
• **metacognitive self-knowledge**	• **muted speech/ mumbling**
• **expressive**	• **unclear/ unrecordable**
• **laughing/ crying/ screaming**	• **non-present speech**

Figure 4.5 Individual speech codes compiled under the category of *context-based speech*

While the large number of codes managed to exhaustively cover the entire range of utterances recorded in the study, many of the codes had very few instances of occurrence. In order to increase the strength of all further speech analyses, the 29 codes were combined into nine *pragmatic speech categories*. These merged categories were also developed on the basis of the intention of the speaker and the pragmatic content of the utterances. **Fig. 4.6** below, tabulates the codes appearing under the nine merged pragmatic speech categories.

Speech: Pragmatic speech	
1. directive	• *directing/ stating a rule* • *proposing a plan* • *instrumental* • *attentional* • *prompting* • *implicit pretend structuring* • *explicit proposal*
2. informative	• *describing one's actions* • *referential* • *enactment* • *ulterior conversation* • *underscoring* • *storytelling*
3. evaluative	• *evaluative* • *consequential/ if-then* • *metacognitive self-knowledge*
4. emotive	• *expressive* • *laughing/ crying/ screaming*
5. seek/respond	• *seek information* • *response*
6. agree/disagree	• *agreement/ affirmation* • *disagreement/ negation*
7. repetitive	• *repeating oneself* • *repeating other*
8. indistinct speech	• *unclear/ unrecordable* • *muted speech/ mumbling*
9. other speech	• *transitional* • *singing/ humming/ word play*

Figure 4.6 List of 29 speech codes merged into nine codes under the behavioural category of *pragmatic speech*, one of the dimensions on the basis of which speech was categorised.

b) Relevance to task

The three-level coding system developed by Berk (1986) is the most commonly used coding framework used in the private speech literature. However, it combines two separate dimensions, namely, the level of maturity of private speech and relevance to task, into the same category (see **Section 2.5.3.4** in the **Literature Review** for a discussion on this issue). Hence, in order to avoid this confusion in the current study, *relevance to task*, was defined simply on the basis of the content of the speech. An utterance was coded as *task-relevant* if it meaningfully referred to the on-going task pertaining to the *goal-oriented episode*. Utterances which clearly referred to things not involved in the on-going task were coded as *task-irrelevant*. Utterances whose content was not clear at all or which involved muted or mumbling speech, but seemed to be produced when the child was actively involved in the on-going task, were coded as *task-relevant*, simply on the benefit of doubt, rather than attributing any higher level of maturity or functionality to such utterances. Hence task-relevant utterances were not automatically considered to be involved in the attainment of the goal. All utterances, after being coded on their pragmatic content, were also categorised on the basis of their relevance to task. **Fig. 4.7** below, tabulates the codes in this dimension of speech.

Speech: Relevance to task
• *task-relevant*
• *task-irrelevant*

Figure 4.7 Individual speech codes compiled under the dimension of *relevance to task*

c) Directed & adapted to

The third and final dimension on the basis of which all utterances were classified, was the directedness and adaptedness to the listener. Hence those utterances which were both, directed to another listener, based on behavioural and linguistic cues, and had their meaning clearly adapted to the listener, were coded as *social speech*. On the other hand, those utterances which did not fulfil both of the above criteria of directedness and adaptedness, were coded as *private speech* (see **Section 2.5.1** in the **Literature Review**, for a discussion on extending the definition of private speech). Based on these criteria, utterances which would have been otherwise labeled as social speech were coded as private, if their content was not adapted according to the shared knowledge

accessible to the other listeners. Such a content was not comprehensible to the other listener, since it held a private meaning, understood only by the speaker. Hence speech utterances were not just assessed as independent units, but were instead analysed for their content and context in relation to other utterances preceding and following it, in order to ascertain the public or private nature of meaning that it held for all the participants in the conversation. Hence, apart from the behavioural and linguistic cues commonly used to distinguish social speech from private speech, an additional criterion of the content and context of speech as a means of identifying private meaning in apparently social utterances was employed in this study. **Fig. 4.8** below, tabulates the codes in this dimension of speech. Such a categorisation also tried to avoid attributing any *a priori* function of self-regulation and communication to private and social speech respectively.

Speech: Directed & adapted to
• *social speech*
• *private speech*

Figure 4.8 Individual speech codes under the behavioural category of *directed & adapted to*, the final dimension on the basis of which speech was categorised

4.2.2.4 Examining speech and behaviour independently

The confusion of various dimensions of speech with the function of speech addressed in the previous section, has been identified by many private speech researchers to be a hindrance in examining the true function of private speech (Atencio & Montero, 2009; Diaz, 1986, 1999; Matuga, 2003). Many have suggested the use of independent behavioural measures of the proposed function of private speech to see their association with different categories of private speech. The suggested association observed in the study was the temporal relation between speech and goal-directed behaviour in real-time. However in order to achieve this, independence between the two measures, namely speech and behaviour, had to be insured. Hence, as pointed out in the previous section, any functional categorisation of speech utterances was avoided, while all categories were defined independently from their effect on behaviour. Hence the dimension of pragmatic content of speech was based on the 'desired' effect that the speaker wanted to achieve through its content rather than any actual effect that it may or may not have had. Similarly, the dimension of relevance

to task did not imply relevance to 'attaining the goal', but simply indicated that the content of the utterance was not off-task, but instead referred to the task at hand. On the other hand, all the codes within the behavioural categories were defined on the basis of behavioural cues, and care was taken to not include any verbal indicators. Although, it would have been ideal to have the speech and behavioural data coded by independent coders, it was not possible to have such an arrangement within the scope of this doctoral project. However a practical measure taken to ensure such an independence was by conducting the coding of speech and behaviour separately in layers, at different points in time. Hence the speech produced in all the goal-oriented episodes was transcribed and categorised first, followed by the coding for the behavioural categories. The two layers of coding were then combined together.

4.2.2.5 Mapping the context of the speech-behaviour relationship

One of the aims of the study was to examine the real-time temporal relationship between speech and behavior while taking into account the context in which this relationship is established. This would be the equivalent of a thick description of the goal-oriented episodes, such that any temporal relationship between speech and goal-directed behaviour that may occur in these episodes can be meaningfully understood. However, it was also necessary to incorporate these details in a systematic way, without going into the specifics of each context, since the activities carried out by the children in the analysed episodes were highly variable in their content. Hence in order to create such a common coding framework applicable to all goal-oriented episodes, only those aspects of the context which were relevant to the goal were recorded. Two types of categories were created for this purpose, namely, *goal-mapping behaviours* and *goal-relevant events.*

Goal-mapping behaviours comprised those behaviours carried out by the focal child which mapped the child's activity in relation to the pursuit of the goal within a goal-oriented episode. These included the following codes - *new goal pursuit, return to previous goal, leave goal pursuit, start focused activity* and *start wandering behaviour.* While the first two codes indicated when the child started or resumed the pursuit of the goal in the analysed episode, the next three codes indicated when the child actively left the pursuit of the goal, and whether after the end of the goal-oriented episode, he pursued a *focused activity* or a *wandering behaviour* (indicated by the behaviours- *start focused activity* and *start wandering behaviour, respectively*). **Fig. 4.9** below, tabulates the codes in this category of behaviours.

Goal-mapping behaviours
• **new goal pursuit**
• **return to previous goal**
• **leave goal pursuit**
• **start focused activity**
• **start wandering behaviour**

Figure 4.9 Individual codes under the behavioural category of *goal-mapping behaviours*

Goal-relevant events highlighted important events which could be relevant to the attainment of the goal within a goal-oriented episode, and their presence could aid in explaining any speech and goal-directed behaviours occurring in its neighbourhood within a stream of behaviour. These comprised the following codes - *distraction, disruption, failed strategy, regulated by other, facilitative event, goal attained* and *failure to attain goal.* **Fig. 4.10** below, tabulates the codes in this category of events.

Goal-relevant events
• *distraction*
• *disruption*
• *failed strategy*
• *regulated by other*
• *facilitative event*
• *goal attained*
• *failure to attain goal*

Figure 4.10 Individual codes under the behavioural category of *goal-relevant events*

Both of these categories involved the behaviour of the focal child in some aspect, but they were distinct from the category of *goal-directed behaviours*, discussed previously, since they were not directly responsible for the attainment of the goal. However, their presence enabled a better understanding of the process of goal-attainment within a goal-oriented episode.

4.2.2.6 Categories arising during data analysis

Two of the categories used in the coding framework were created during the data analysis to enable a better understanding of the trends in the data that were visible early on. The influence of the presence of others in the vicinity, particularly of an adult, as well as that of peers has been extensively researched in the private speech as well as the self-regulation literature (refer to **Section 2.5.8** in the **Literature Review** for a review of this issue). Although some teacher was always present in the classroom, it was clear from the recordings of the classroom activities that direct involvement of an adult, particularly the teacher, inhibited the children's spontaneous display of self-regulation as well as speech output. Due to the exploratory nature of this study which aimed to examine the relationship between speech and behaviour, a high yield of speech and behaviour was required. Hence a contextual category of *adult involvement* was created with the codes *adult involved* and *adult uninvolved.* This coding was applied to the entire recording of the classroom data, and only those time periods where an adult was uninvolved was used for further analysis. It was not possible to examine the data recorded during *adult involved* and compare it with the *adult uninvolved* situation, due to the limited scope of this study. In the laboratory-based task, although the researcher was present in the laboratory during a major period of the task, she was only involved directly on a few occasions to assist the child or the dyad when they got distracted from the task or were visibly frustrated or discouraged after facing an obstacle in the task. However, on most such occasions when the adult was involved, the researcher would only actively intervene in the task till the obstacle could be overcome by the child or the dyad. After that, the researcher continued to stay in the laboratory but was uninvolved, as she did not participate in the task, and gradually withdrew from the child/dyad and pretended to continue with her work at a nearby table in the same room, turning her back to the child/dyad. At this point, the child/dyad very quickly ignored the researcher and continued with the task without interacting with the researcher. For the rest of the task, the researcher was physically absent from the observational room. This was only possible in the laboratory (and not in the classroom), and hence in the laboratory recording, an additional code of *adult absent* was used. For the laboratory recordings, periods under *adult uninvolved* and *adult absent* were used for further analysis. **Fig. 4.11** below, tabulates the codes in

this contextual category, for the classroom and the laboratory recordings.

Adult involvement
• *adult involved*
• *adult uninvolved*
• *adult absent (lab only)*

Figure 4.11 Individual codes under the contextual category of *adult involvement,* applied in the classroom and laboratory settings

The effect of the physical presence of peers during the classroom activities was more difficult to discern, since, in a busy preschool classroom, occasions when a child was playing in a completely solitary condition were very rare. Duration of goal-oriented episodes in the solitary condition was only 13min 54s, a mere 8.9% of the total duration of all goal-oriented episodes. Children were mostly engaged in an activity in groups of two or more, or were at least physically surrounded by other classmates, even if not engaged in the same activity. Therefore, the physical presence of peers was a near-constant feature of the naturalistic data recorded in the classroom. On the other hand, the data recorded during the laboratory-based task could be clearly differentiated between the solitary condition when a single child was engaged in solving the task, and the group condition, when a dyad were expected to solve the task together. Hence it was not possible to compare the data in the solitary versus the group condition across the classroom and the laboratory context. However, during the initial phases of data analysis, it was clear that the children in the classroom, even in the group condition, were interacting differently with their peers, depending upon their need to interact with others due to a shared concern. This could be compared to the different categories of play devised by Parten (1932), based on the type of social interaction observed between the children. The last three categories of play in this system of classification, namely, *parallel, associative* and *cooperative play,* involved the presence of peers, but at increasing levels of interaction. These have been defined in the play literature as follows: *parallel* - playing beside other children with similar objects without interacting with them; *associative* - engaged in separate activities from others playing nearby but interacting with them verbally and through exchange of toys; and *cooperative* - involved with other children in a mutual play activity where all have a role to perform. In this study, all goal-oriented episodes did not necessarily involve play activities, in the strictest sense of the

term. Hence such a classification could not be applied consistently throughout the dataset. However, seen from the perspective of goal-orientation, it was clear that a child interacted differently with others in activities whose goal was mutually shared by others, compared to activities whose goal was individually pursued by the child, in spite of being physically surrounded by others, and even engaged in seemingly group-based activities. Hence, social interaction seemed to depend on whether the goal of an episode was shared with others, or was personal to the child. Based on this observation, another category, namely *goal-sharing context,* was created in the coding framework to classify all goal-oriented episodes on the basis of the nature of their goal as shared or personal. Personal goals were coded as *I_goal,* while shared goals were coded as *we_goal.* **Fig. 4.12** tabulates the codes in this contextual category.

Goal-sharing context
· *I_goal*
· *we_goal*

Figure 4.12 Individual codes under the contextual category of *goal-sharing context*

4.3 Prevalence of spontaneous speech

This section provides the descriptive statistics of the overall spontaneous speech utterances recorded in the study, during both the phases, namely the naturalistic recordings obtained in the classroom and the recordings of the laboratory-based task.

4.3.1 Classroom phase

The eight children were observed during 64 goal-oriented episodes in the classroom with the total duration of 155 min and 30s. A total of 1220 spontaneous speech utterances were produced by the children, across episodes of varying durations in the classroom. Out of this 335 utterances were private (27% of total utterances) while 885 utterances were social in nature (73% of total utterances). The speech categories were further divided into *task-relevant* and *task-irrelevant* speech, depending on whether the content of the speech was relevant to the current goal of the episode or not. Due to the variable duration of these goal-directed episodes, raw number of speech utterances and behavioural events were converted into rates of occurrence per minute (RpM). **Table 4.4** shows the raw number of utterances and percentage of total utterances of private and social speech in the first two rows. The next two rows show mean rates per minute (RpM) and mean percentage of episodes in which the event occurs (% of episodes) along with their standard deviations (S.D.) in brackets, of private and social speech averaged across the 8 children, during their classroom activities.

Table 4.4 Private and social speech metrics averaged across the children (N = 8) during goal-directed classroom activities

	Private			Social		
	ps_all	*relevant*	*irrelevant*	*soc_all*	*relevant*	*irrelevant*
# of utterances	335	308	27	885	792	93
% of all speech	27.4	25.2	2.2	72.5	64.9	7.6
RpM (S.D)	2.29 (1.03)	2.03 (0.93)	0.25 (0.35)	6.13 (2.41)	5.29 (2.54)	0.84 (0.89)
% of episodes	80.6 (20.5)	80.6 (20.5)	26.17 (17.4)	92.4 (9.7)	92.4 (9.7)	27.7 (23)

4.3.2 Laboratory phase

The same eight children were observed during Phase II of the study, conducted in a laboratory-based setting. The total analysed duration of the laboratory-based data was 27 min and 2s. A total of 226 spontaneous speech utterances were produced by the children in the recorded data. Out of this 124 utterances were private (55% of total utterances) while 102 utterances were social in nature (45% of total utterances). Of the eight children, four of them completed the task in the *solitary* condition, while the other four completed the task as a *dyad*. The total analysed duration of the laboratory-task in the solitary condition was 16 min and 29s, while the total analysed duration in the dyad condition was 10 min and 33s. **Table 4.5** shows the raw number of utterances and percentage of total utterances of private and social speech in the *overall* condition (comprising data from all eight children), in the first two rows. The next two rows show the raw number of utterances recorded in the solitary and dyad conditions, respectively. The last three rows show mean rates per minute (RpM) along with their standard deviations (S.D.) in brackets, of private and social speech in the overall, solitary and dyad conditions, respectively.

Table 4.5 Private and social speech metrics averaged across the children during the lab-based task, in the overall (N=8), solitary (N = 4) and dyad (N=4) conditions

	Private			Social		
	ps_all	*relevant*	*irrelevant*	*soc_all*	*relevant*	*irrelevant*
# of utterances (overall)	124	124	0	102	80	22
% of all speech (overall)	55%	55%	0	45%	35%	10%
# of utterances (solitary)	92	92	0	13	2	11
# of utterances (dyad)	32	32	0	89	78	11
RpM (overall)	4.20 (3.5)	4.20 (3.53)	0	4.70 (4.58)	3.72 (3.94)	0.97 (1.49)
RpM (solitary)	5.27 (5.00)	5.27 (5.00)	0	0.73 (0.61)	0.12 (0.24)	0.60 (0.65)
RpM (dyad)	3.13 (0.97)	3.13 (0.97)	0	8.67 (2.56)	7.33 (1.24)	1.34 (2.10)

4.4 Prevalence of goal-related behaviour

Descriptive statistics of all the goal-related behaviours recorded during the classroom activities and during the laboratory-based 'tidy-up' task are presented below. Statistic are given for the three categories of behaviour, namely, *goal-directed behaviours, goal-mapping behaviours* and *goal-relevant events,* with a total of 20 separate behavioural categories distributed amongst these three categories.

4.4.1 Classroom phase

The eight children produced a total of 2905 instances of goal-related behaviours. Out of these, there were 1640 instances of *goal-directed behaviours* (56% of total instances of behaviour), 464 instances of *goal-mapping behaviours* (16% of total instances of behaviour) and 801 instances of *goal-relevant events* (28% of total instances of behaviour). Due to the variable duration of these goal-directed episodes, raw occurrence of behavioural events was converted into rates of occurrence per minute (RpM). **Table 4.6** shows the raw number of instances of goal-related behaviours and percentage of total instances of goal-related behaviours. These are followed by mean rates per minute (RpM) along with their standard deviations (S.D.) in brackets, for each of the goal-related behaviours, averaged across the 8 children, during their classroom activities. Each of these measures are reported separately for personal (I_goals) and shared goals (we_goals).

Table 4.6 Descriptive statistics of goal-related behaviours (goal-directed behaviours, goal-mapping behaviours and goal-relevant behaviours) averaged across the children (N = 8) during goal-directed classroom activities. These activities are divided on the basis of the nature of goal-sharing into personal (I_goals) and shared goals (we_goals).

	goal-related behaviours	# of instances		% of all instances		RpM (S.D.)	
		I_goal	we_goal	I_goal	we_goal	I_goal	we_goal
goal-directed behaviour	ROUTINE	283	328	19.7	22.4	4.498 (1.948)	1.323 (2.027)
	CHANGE	160	187	11.1	12.7	2.452 (1.068)	1.912 (2.309)
	SEARCH	58	43	4.0	2.9	0.745 (0.662)	0.912 (0.492)
	REGULATE	52	35	3.6	2.4	0.536 (0.462)	0.608 (0.460)
	SEEK HELP	6	2	0.4	0.1	0.195 (0.246)	0.435 (0.379)
	CHECK	111	113	7.7	7.7	1.518 (0.046)	1.716 (2.181)
	NOTICE	96	105	6.7	7.2	1.183 (0.911)	1.904 (1.397)
	REPEAT	31	30	2.2	2.0	0.508 (0.420)	0.471 (0.450)
goal-relevant event	ATTAIN_G	79	61	5.5	4.2	1.859 (1.553)	2.048 (1.267)
	FAIL_G	25	14	1.7	1.0	0.343 (0.268)	0.626 (0.640)
	FAIL_STR	120	91	8.3	6.2	1.943 (1.172)	4.323 (2.197)
	DISTRACT	54	49	3.8	3.3	0.645 (0.340)	1.803 (1.439)
	DISRUPT	35	52	2.4	3.5	0.370 (0.295)	1.222 (0.956)
	FACILITATE	30	60	2.1	4.1	0.453 (0.502)	0.791 (0.769)
	REGULATED	65	66	4.5	4.5	0.779 (0.486)	0.827 (2.159)
goal-mapping behaviour	NEW_G	122	109	8.5	7.4	2.834 (1.834)	0.302 (0.395)
	RETURN_G	23	38	1.6	2.6	0.312 (0.233)	0.764 (0.380)
	LEAVE_G	35	45	2.4	3.1	1.228 (2.358)	0.268 (0.349)
	FOCUS_A	35	25	2.4	1.7	0.691 (0.814)	1.778 (1.039)
	WANDER	18	14	1.3	1.0	0.194 (0.225)	0.355 (0.226)

• ROUTINE=routine strategy; CHANGE = change strategy; SEARCH=search strategy; REGULATE=regulate other; SEEK HELP=seek help; CHECK=check progress; NOTICE=notice error/issue; REPEAT = repeat failed strategy; NEW_G=new goal pursuit; RETURN_G=return to previous goal; LEAVE_G=leave goal pursuit; FOCUS_A=start focused activity; WANDER=start wandering behaviour; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others.

4.4.2 Laboratory phase

In the 'tidy-up' task, the eight children produced a total of 928 instances of goal-related behaviours. Out of these, there were 576 instances of *goal-directed behaviours* (62% of total instances of behaviour), 254 instances of *goal-mapping behaviours* (27% of total instances of behaviour) and 98 instances of *goal-relevant events* (11% of total instances of behaviour). Due to the variable analysable duration of the 'tidy-up' task, raw occurrence of behavioural events was converted into rates of occurrence per minute (RpM). **Table 4.7** shows the raw number of instances of goal-related behaviours and percentage of total instances of goal-related behaviours. These are followed by mean rates per minute (RpM) along with their standard deviations (S.D.) in brackets, for each of the goal-related behaviours, averaged across the 8 children, during the 'tidy-up' task in the laboratory.

Table 4.7 Descriptive statistics of goal-related behaviours (goal-directed behaviours, goal-mapping behaviours and goal-relevant behaviours) averaged across the children (N = 8) during the 'tidy-up' task in the laboratory.

	goal-related behaviours	# of instances	% of all instances	RpM (S.D.)
goal-directed behaviour	ROUTINE	158	17.0	6.331(2.242)
	CHANGE	178	19.2	6.661 (1.382)
	SEARCH	25	2.7	1.075 (0.695)
	REGULATE	6	0.6	0.324 (0.803)
	SEEK HELP	4	0.4	0.206 (0.384)
	CHECK	116	12.5	4.263 (1.315)
	NOTICE	60	6.5	2.434 (1.176)
	REPEAT	29	3.1	1.024 (0.637)
goal-relevant event	ATTAIN_G	79	8.5	1.660 (0.719)
	FAIL_G	25	2.7	0.193 (0.180)
	FAIL_STR	98	10.6	3.665 (1.497)
	DISTRACT	4	0.4	0.720 (0.637)
	DISRUPT	11	1.2	0.434 (0.480)
	FACILITATE	25	2.7	1.245 (1.571)
	REGULATED	12	1.3	0.640 (0.824)
goal-mapping behaviour	NEW_G	60	6.5	1.339 (0.763)
	RETURN_G	7	0.8	0.210 (0.196)
	LEAVE_G	13	1.4	0.556 (0.519)
	FOCUS_A	15	1.6	0.691 (0.750)
	WANDER	3	0.3	0.080 (0.227)

•ROUTINE=routine strategy; CHANGE = change strategy*;* SEARCH=search strategy; REGULATE=regulate other; SEEK HELP=seek help; CHECK=check progress; NOTICE=notice error/issue; REPEAT = repeat failed strategy; NEW_G=new goal pursuit; RETURN_G=return to previous goal; LEAVE_G=leave goal pursuit; FOCUS_A=start focused activity; WANDER=start wandering behaviour; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others.

4.5 Verifying t-pattern through randomisation

It is possible that the number of t-patterns detected in the data were simply obtained by chance, due to the large number of events coded in the classroom (4125 events: 1220 speech utterances & 2905 goal-related behaviours) and the laboratory dataset (1154 events: 226 speech utterances & 928 goal-related behaviours). In order to rule out this possibility, the events in the two datasets were randomised through five randomisation runs, keeping the same number and frequency of events as the original data, however arranged in a random temporal order. T-pattern searches were initiated within both the randomised datasets using the same search parameters as t-pattern searches within the original datasets. The mean number of patterns in the randomised datasets was compared with the number of patterns detected in the original datasets. If many more patterns are found in the original data than in the randomised dataset, this indicates that the patterns in the dataset are unlikely to be found by chance.

The results of the t-pattern searches for the original and randomised datasets for the classroom (**Fig. 4.13**) and laboratory datasets (**Fig. 4.14)** are presented in Pattern Length Distributions charts, plotting the pattern length on the X-axis, and the (mean) number of patterns on the Y-axis. The red bars in the chart denote the mean number of patterns in the randomised dataset, and the green bars denote the number of patterns in the original dataset. The red line denotes the mean number of patterns in the randomised data plus one standard deviation. The results revealed a very small number of patterns detected in the randomised datasets when compared to the original datasets for both the classroom and the laboratory settings. This supports the claim that the t-patterns detected in the datasets are not simply a consequence of the high number of events coded in the data. Instead, the patterns reveal an underlying temporally structured characteristic of the behaviour expressed.
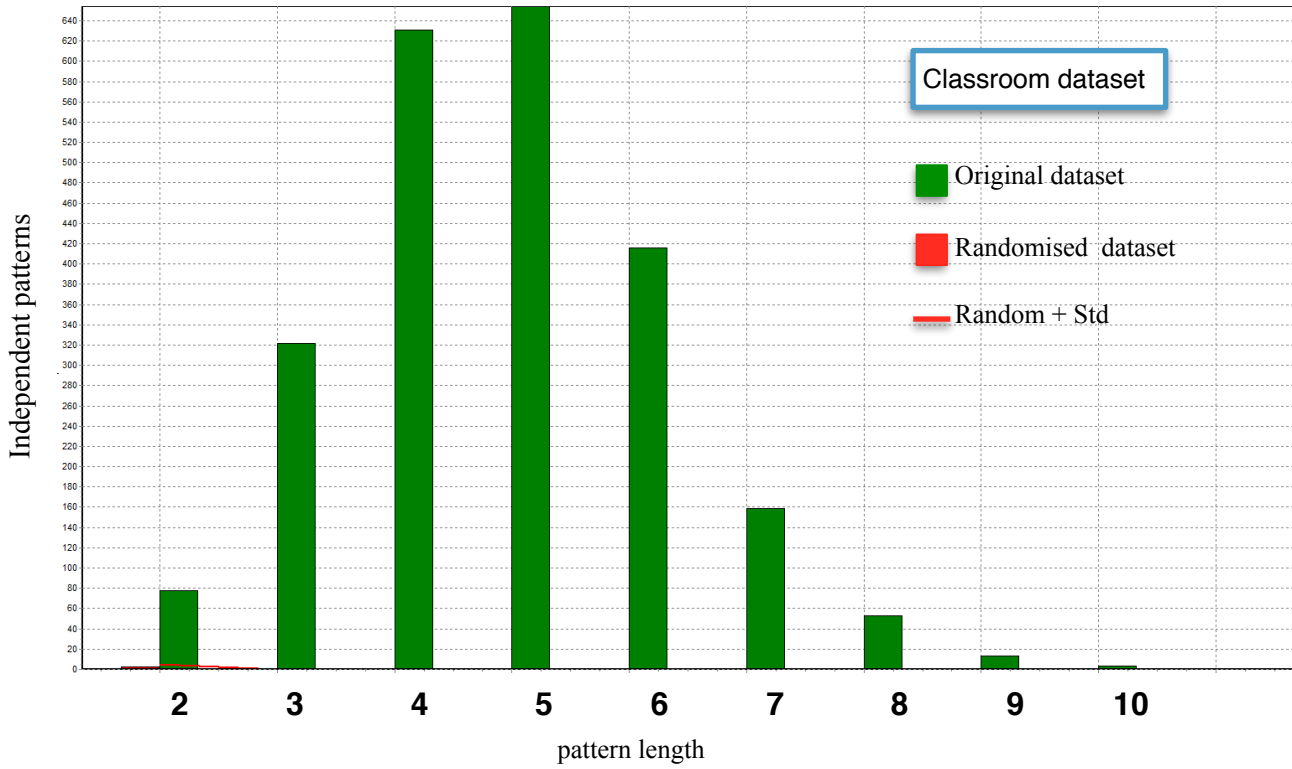
Figure 4.13 Pattern Length Distributions chart comparing mean number of t-patterns between the randomised and original form of the classroom dataset.
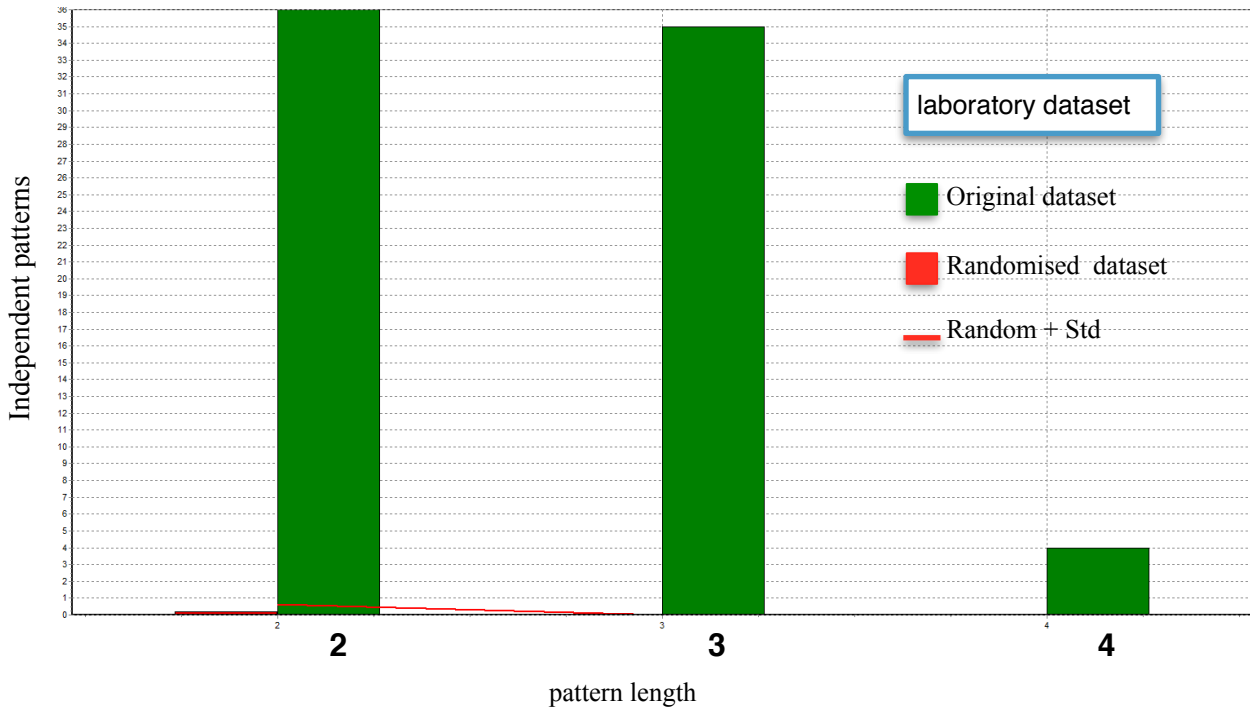
Figure 4.14 Pattern Length Distributions chart comparing mean number of t-patterns between the randomised and original form of the laboratory dataset.

4.6 Summary of Results

The first part of the chapter described the coding framework developed in this study, to examine the temporal relationship between speech and goal-directed behaviour, while capturing the surrounding context relevant to the overarching goal of the behaviour under observation. The coded data, obtained as a result of applying such a framework, were critical for properly examining the issues raised in the subsequent research questions governing this study. The framework also managed to resolve some of the methodological issues pertaining to previous studies in the private speech and self-regulation literature. The inter-rater reliabilities for all the categories in the framework were classified as either 'substantial' agreement or 'almost perfect' agreement according to Landis & Koch (1977). Their significance will be discussed in detail in **Chapter 8 (*Discussion*)**. The second part of the chapter reported the prevalence of spontaneously produced social and private speech (both task-relevant and task-irrelevant), during the classroom and the laboratory phase. Similarly, prevalence of goal-related behaviours in the two settings were also reported. This was followed by a description of the randomisation procedure followed to validate the t-patterns obtained through both the datasets (classroom and laboratory).

Does the context of shared versus personal goals influence the occurrence of private and social speech during goal-oriented episodes?

Hypothesis: Private and social speech would not show a difference in their rate of production between shared goal and personal goal contexts since both types of speech might be used in the two contexts for regulating and communicating with oneself and with others. However the two goal contexts might show differences in the way speech utterances occur in conjunction with certain types of behavior, namely those related to regulating others directly or indirectly in the shared goal context, as opposed to the personal context.

5.1 Summary of Analysis

Participants in the study spontaneously engaged in goal-directed behaviour in the classroom, which were driven both by personal goals as well as shared goals. Contexts where the goal of a goal-oriented episode had been set by the child herself, the goal was not shared by others around her, and she was engaged in attaining that goal through individual effort were categorised in the data as personal goal contexts and coded as *I_goal* episodes. On the other hand, shared goal contexts were governed by goals that might have been initiated by the child herself or by other member/s of the group, but once a goal had been set, it was shared by other members of the group (2 or more children) who were jointly engaged in attaining that goal. These were coded as *we_goal* episodes.

It is expected that I_goal episodes, wherein the focal child was individually involved in the attainment of a personal goal, would present opportunities to the child for self-regulation only, along with some communication with others present in the vicinity. This communication might be mostly task-irrelevant, since the others were not involved in the goal-oriented task at hand. Episodes with we_goals would also involve self-regulation for attaining the shared goal. But it would additionally involve instances of both *co-regulation* (regulating the behaviour of a specific member of the group) and *shared regulation* (jointly regulating the collective activity of the group) which would require task-relevant communication with others. If the conservative view of the functional differences between private and social speech is assumed, whereby private speech is only

reserved for self-regulation while social speech is for communication with others only, then task-relevant social speech would be more frequent within we_goals than I_goals. However, if the functions of social and private speech are not so exclusively limited and both private and social speech are involved in the regulatory and communicative functions required in the two goal contexts, as has been argued through the Contextual Model of Speech Function proposed earlier (**Section 2.5.2.3**, **Figure 2.2**.), then no significant differences in the rate of speech production between I_goal and we_goal contexts would be observed. Hence task-relevant speech might be produced at similar rates in both goal contexts, but depending upon the personal or shared nature of the goal, the speech utterances might perform different functions. In order to test this two-part hypothesis, two types of analyses were carried out.

In order to examine the first part of the hypothesis, the quantity of speech produced in the two goal contexts were compared by testing for any differences in the mean rates of speech productions for the 8 children in the I_goal and we_goal contexts. The comparisons were carried out for social and private speech separately. The second part of the hypothesis claimed that there would be differences in the functions that private as well as social speech might be performing in the two goal contexts. A preliminary method of comparing correlation coefficients was employed to test this. Correlations between task-relevant speech and goal-related behaviours in the two goal contexts were computed, for private and social speech separately. The correlation coefficients (rho values) were back-transformed to z-values and then compared to see if there was any difference between the correlations obtained in the I_goal and the we_goal contexts for certain types of behaviours with respect to the context. Such a method can only be preliminary, since correlational analyses are inherently limited in delineating the functions of speech with respect to behaviour, particularly in real-time (see **Section 2.5.6 in the Literature Review** for a discussion). Data regarding temporal co-occurrence of speech and behaviour in real-time would be needed to carry out the kind of functional analysis of speech required above. However if a method based on correlational data itself is able to show a difference in the type of speech and behaviour relation in the two goal contexts, it would be sufficient evidence for considering the goal-sharing context as an important contextual factor influencing the nature of verbal mediation of behaviour exhibited by children in their goal-oriented activities.

It is important to note here that due to the limited scope of the study, only self-regulatory behaviour of the focal child was coded systematically. *Regulate others* was the only behavioural code under the category of goal-directed behaviours, which indicated *co-regulation* (regulation of the behaviour

of another member of the group), from the perspective of the focal child (refer to **S**ection **4.2.1.3** in **General Results** chapter for a definition and example of this code). The study could not investigate the behaviour of the whole group as a single unit of analysis due to its limited scope. Hence the coding framework did not have any behavioural codes indicating *shared regulation* (joint regulation of the collective activity of the group). Therefore the correlation of speech utterances with various behavioural categories might be limited in delineating the function of *other-regulation* (comprising both co-regulation and shared regulation) for speech utterances. It is also a possibility that children at this young age only engaged in self-regulation without systematically regulating others towards the shared goal.

However, even with the limited scope of coded behavioural categories in the study, the various codes captured different occasions during a goal-oriented episode, where speech might be used for performing different types of functions. For example, codes within categories such as *goal-directed behaviours* (for e.g., *routine strategy, change strategy, check progress, notice error/issue*) represented moments of successful self-regulation, and a high correlation of speech with such behaviours might indicate a regulatory function of speech, both for personal as well as shared goals. On the other hand, codes within categories such *goal-relevant events* (for e.g., *failure to attain goal, disruption, distraction, failed strategy*) and *goal-mapping behaviours* (for e.g., *leave goal pursuit, start wandering behaviour)* represented moments of difficulty in a task or the resulting response to such difficulties, and a high correlation of speech with such behaviours might indicate varied functions, both regulatory (such as resisting distraction, managing one's response to failure, avoiding confrontation) as well as communicative (informing others, plea for help), depending upon the context. This has been discussed in greater detail in the context of the second research question. However, at this point, it is sufficient to say that any difference in the correlation coefficients obtained in the two goal contexts would make a strong case for factoring the effect of the goal-sharing context when carrying out all further analyses in the present study.

Finally, it could be argued that I_goals were mostly carried out when the focal child was solitary as compared to we_goals which were inevitably pursued when the child was in a group. Hence any differences in the use of private and social speech in the two conditions could simply be attributed to peer presence rather than the goal-sharing context. However not all I_goals were pursued in the absence of others. In fact the duration of I_goals carried out in the presence of others made up 83% (70.14 minutes) of the total duration of all I_goals recorded in the classroom, while I_goals in the solitary condition only comprised 17% (13.92 minutes) of the total duration. Hence in order to rule

out the effect of peer presence, only those I_goals which were pursued in the presence of others were analysed and compared with the we_goal condition in all further analyses.

5.2 Differences in rate of speech production

In order to test for any differences in the amount of speech production in the two goal contexts, the mean rates of task relevant private and social speech recorded in the classroom averaged across the 8 participants were compared in the I_goal and the we_goal context using the Wilcoxon signed-rank test. **Table 5.1** shows the mean rates per minute (RpM) along with their standard deviations (S.D.) in brackets, of task-relevant private and social speech averaged across the 8 children, in the two goal contexts.

Table 5.1 Mean RpM (N = 8) of task-relevant social and private speech in I_goal and we_goal contexts, with standard deviations in bracket.

Type of speech	Goal context	
	I_goal	we_goal
private[n.s.]	1.91 (1.47)	1.32 (0.94)
social[n.s.]	6.34 (3.79)	6.81 (2.11)

[n.s.] = not significant.

No significant differences were found for the rate of task-relevant private speech ($Z = -1.1202$, $p = 0.263$) or social speech ($Z = -0.560$, $p = 0.575$) between the I_goal and the we_goal context. Social speech in both goal contexts was higher than private speech (I_goal: $Z = -2.380$, $p = 0.017$; we_goal : $Z = -2.521$, $p = 0.012$), as is expected by the low rate of private speech reported in most private speech studies. Hence, as predicted, there was no difference in the rate of task-relevant private speech or social speech production between the two goal contexts.

5.3 Differences in speech-behaviour correlations

The second part of the hypothesis predicted that the function of speech in the two contexts might be different in spite of the similar rates of production. This purported difference in function was investigated by examining differences in the correlation between speech and particular goal-related behaviours in the two goal-contexts.

5.3.1 Private speech and goal-related behaviour

Hence the Spearman's rank correlation coefficients (rho values) between overall rate of private speech and rate of goal-related behaviours were computed in the two goal conditions (See **Appendix E**). The rho values obtained in the two goal contexts were converted to z-values and then compared using a back-transformed average Fisher's (1921) Z procedure (Diedenhofen & Musch, 2015). **Appendix F** lists the results of the comparison of rho values between I_goal and we_goal. A higher rho value for the correlation between overall task-relevant private speech and the goal-relevant event: *goal attained* was observed in the we_goal context (Z = -.3.56, p = 0.0004) when compared to the I_goal context. Correlations between overall private speech and all other behavioural categories were similar in the two goal contexts. Since overall private speech and *goal attained* demonstrated a highly significant strong negative correlation in the I_goal context (r(6) = -0.97, p = 0.00003) compared to the non-significant positive correlation in the we_goal context (r(6) = 0.476, p = 0.233), this would have been reflected in the higher rho value in the we_goal when compared to the I_goal context. Moreover, no significant differences were found between the mean rate of occurrence of *goal attained* behaviour (Z = -1.9604, p >0.05) in the I_goal and we_goal contexts. However the implication of the above-mentioned negative correlation for the real-time temporal relationship between private speech utterances and *goal attained* events in I_goal episodes might be difficult to explain without further temporal analysis of the data. Such a detailed temporal analysis involving both correlations in conjunction with real-time co-occurrence was carried out in Chapter 6 (**Section 6.5.1**) .

5.3.2 Social speech and goal-related behaviour

When a similar comparison for task-relevant social speech was carried out (See **Appendix E & F**), higher rho values for overall social speech in the we_goal context were observed with the following goal-directed behaviours: change strategy (Z = -2.21, p = 0.027) and notice error/issue (Z = -2.41, p = 0.015), when compared to the I_goal context. Correlations between overall social speech and all other behavioural categories were similar in the two goal contexts. In this case, social speech in the we_goal context demonstrated a strong positive correlation with change strategy (r(6) = 0.643, p = 0.046) as well as notice error/issue (r(6) = 0.786, p = 0.021), in comparison to the negative correlations in the I_goal context (change strategy: r(6) = -0.500, p = 0.207); notice error/issue: (r(6) = -0.405, p = 0.320). While positive correlations do not reveal any information about the real-time co-occurrence between these goal-directed behaviours and social speech utterances, one may

tentatively put forth some explanation based on co-occurrence, before further temporal analysis is carried out in the next chapter. Hence, in we_goal episodes, a change of strategy could have been an occasion for using social speech to inform others involved in the shared goal about the goal-relevant changes. On the other hand, noticing an error could have flagged goal-relevant issues which might have entailed both informing others about the noticed error/issue, as well as the regulation of other members of the group towards the shared goal using social speech. However I_goal episodes might not have presented any occasions to inform or regulate others, especially since the goal of the episode was not shared with others.

While this method of comparing non-overlapping correlational coefficients does highlight some differences in the statistical relationship between speech and behaviour in the I_goal and we_goal contexts, particularly in the case of social speech use, it is not sufficient evidence for confirming any qualitative differences in the way speech is produced in conjunction with behaviour in these two contexts. This can only be confirmed through detailed temporal analysis of the data which will be carried out in Chapter 6. However, the results obtained so far do present substantial evidence for advocating a separation of the data on the basis of the goal-sharing context.

5.4 Summary of Results

Based on the correlational analysis of speech and behaviour measures in the two goal-sharing contexts, the results suggest that speech might be occurring with goal-related behaviours in different ways in the I_goal and the we_goal contexts. However, only a detailed analysis of the temporal patterns of occurrence of speech and behaviour can provided more substantial evidence regarding different types of verbal mediation occurring in the two goal contexts. This has been taken up in the second research question, in the next chapter. However, based on the results obtained so far, one can answer in the affirmative to the research question raised at the beginning of the chapter that *the context of shared versus personal goals does influence the occurrence of private and social speech during goal-oriented episodes*. Hence apart from the categorisation of speech into private and social, the goal context in which this speech is produced also needs to be considered in any analysis of verbal mediation of behaviour. Hence the goal condition has been taken into account in all further analyses in this study.

Chapter 6. Results: Research Question 2

6.1 Introduction & Structure of Chapter

The results of the second and the principle research question of the study are presented in this chapter. Evidence for real-time verbal mediation of goal-related behaviours were examined, both for private as well as social speech, under the two goal-sharing conditions, namely personal and shared goals. Analysis revealed different functions of speech, determined by the goal-sharing condition and type of speech produced by the children. Results discussed in this chapter came from the data collected during the classroom recordings. The methodology employed in obtaining these results involved a combination of quantitative and qualitative methods. Correlational data obtained for speech-behaviour pairs were matched against their co-occurrences within t-patterns, in order to arrive at instances of temporal interaction between goal-related speech and behaviour. Those instances were then contextually analysed to reveal real-time verbal mediation of behaviour during goal-directed regulation as well as communicative functions of speech aimed at managing a situation or informing others during goal attainment. These results were explained through the Contextual Model of Verbal Mediation, proposed in Chapter 2. The summary at the end of the chapter highlight some of the important contributions made by the obtained results to the private speech research.

Research Question 2: What is the role of task-relevant private and social speech in the verbal mediation of behaviour in the two goal-sharing conditions?

Hypothesis: Task-relevant private and social speech would positively correlate with certain goal-directed behaviours and goal-relevant events, and would additionally co-occur with a subset of these behaviours in temporal patterns, indicating either real-time verbal control or verbal commentary, depending upon the sequence and context in which speech and behaviour occur in the pattern.

Previous research has shown various measures of self-regulation required in a task to be correlated with frequency of task-relevant private speech. The correlation may be indicative of several mechanisms. One mechanism which can explain this correlation is that private speech use has an overall effect on self-regulatory capacity of an individual through a mechanism operating on a longer time-scale rather than having an immediate real-time effect on self-regulatory events. Such a mechanism might manifest as a self-regulatory trait rather than an event. A hidden factor mediating both speech production and behaviour could also contribute to such a correlation. In such a case, speech and behaviour categories might be correlated, but would not show any real-time co-occurrence. Analyses of both correlational coefficients and temporal co-occurrence of speech and behaviour might point towards such a mechanism and be reflected in the data as *correlation without co-occurrence.*

Another mechanism which can explain the correlation found in previous studies is a real-time *verbal control* of behaviour by private speech utterances. If this is the case, then the correlations between private speech and behaviours would be coupled with temporal co-occurrence in real-time data and private speech would always precede self-regulatory behaviours. Let us call this *scenario 1*. Another explanatory mechanism may be *verbal commentary* of the behaviour by private speech utterances*,* wherein correlations between private speech and behaviours would be coupled with temporal co-occurrence in real-time data, as above, but with private speech always occurring after self-regulatory behaviours. Let us call this *scenario 2*. However it might be a mixed scenario of some speech occurring immediately before behaviour and some speech occurring immediately after behaviour. This may indicate both types of mechanisms, namely *verbal control* and *verbal commentary*, involved in real-time verbal mediation of behaviour, and taking place together in a goal-oriented episode. The cognitive, social, motivational and emotional requirements of a situation may determine the mechanism invoked in any particular situation. Both of these mechanisms of verbal mediation may be reflected in the data as *correlation with co-occurrence.*

The following sections describe the analyses which were carried out to answer the second research question by investigating if verbal mediation of behaviour indeed took place in the goal-oriented episodes recorded in this study, and if it did, then which of the above-mentioned mechanisms of verbal mediation were revealed in the naturalistic data. Two types of analyses, namely, standard correlational analysis and t-pattern analysis, were carried out to address this research question.

Correlations between pragmatic categories of private speech and the various goal-related behaviours were computed in the correlational analysis, whereas temporal patterns of co-occurrence of private speech categories and goal-related behaviours was searched through t-pattern analysis. In order to additionally examine the role of social speech, the above analyses were also carried out for task-relevant social speech produced during the same goal-directed episodes. The results obtained from the first research question had made a strong case for separating the goal-directed episodes on the basis of their goal-sharing context before carrying out any functional analysis of speech and behaviour. Hence the above analyses were conducted separately for episodes governed by the two goal-sharing contexts, namely the I_goal and the we_goal contexts. In order to rule out the effect of social presence of other peers in the we_goal compared to the I_goal context, only those I_goal episodes were analysed which took place in the physical presence of other children, rather than those I_goals which were pursued in solitude. Hence the combination of type of speech and goal-sharing context resulted in 4 conditions of analysis, namely private speech analysed within the I_goal context (ps_I_goal), private speech analysed within we_goal context (ps_we_goal), social speech analysed within I_goal context (soc_I_goal) and social speech analysed within we_goal context (soc_we_goal).

Speech-behaviour pairs which were significantly correlated were then matched against the t-patterns extracted from the data, to examine if the correlated pairs also co-occurred within the t-patterns. Hence, the results obtained through the correlational and t-pattern analyses fell into three categories: *correlation without co-occurrence*, *co-occurrence without correlation* and *correlation with co-occurrence*. Those speech-behaviour pairs which fulfilled the criterion of correlation with co-occurrence qualified as suitable examples for representing the verbal mediation of behaviour in real-time. The results of this analysis revealed that different types of goal-related behaviours co-occurred with certain pragmatic categories of speech under each of the four speech and goal-sharing conditions, and hence indicated different functions of speech in each of the goal-sharing contexts. The results thus obtained were then compared against the various functions of speech predicted by the Contextual Model of Verbal Mediation, proposed earlier in **Chapter 2** (**Section 2.5.2.3**). However in order to thoroughly investigate the functional roles of private and social speech in the real-time verbal mediation of behaviour, those t-patterns from which the correlated and co-occurring speech-behaviour pairs had been selected were contextually analysed, by going back to the sections of the recorded naturalistic data from where these t-patterns had been extracted. The types of speech profiles which were predicted by the Contextual Model to be found in the various

speech and goal conditions were confirmed to be present in the analysed episodes. The details of these step-by-step analyses are given below in different sections.

6.3 Correlational Analysis

Spearman's rank correlation coefficients were computed across all the individual observations (n = 64), between the rate per minute production of the nine *pragmatic categories*, as well as *overall private* or *social speech* and rate per minute occurrences of the three categories of *goal-related behaviours,* namely*, goal-directed behaviours* (GDB)*, goal-mapping behaviours* (GMB) and *goal-relevant events* (GRE) in the I_goal and we_goal conditions. Hence, there were ten speech categories and twenty behavioural categories during each correlation. Hence in each condition, pairwise correlations were computed between a total of 30 variables of speech and goal-related behaviours. The correlation matrices for the four speech and goal conditions - ps_I_goal, ps_we_goal, soc_I_goal and soc_we_goal are tabulated in **Tables 1,2,3** and **4** respectively, in **Appendix G**. Since the relation between speech and behaviour was the focus of this analysis, correlations amongst the speech categories and amongst the behavioural categories are not reported here. The correlation coefficients with a 2-tailed significance of $p<.01$ are highlighted in red whereas those with $p<.05$ are highlighted in orange.

The significance level, or alpha value, established a priori is the probability of committing the so-called Type I error, which is the sampling frequency at which the null hypothesis will be rejected when it is true. However, this probability is related only to a single comparison between two variables. The probability of committing Type I error increases when multiple comparisons are being conducted for several variables. Consequently, as the number of pairwise correlations being conducted increase, more 'significant' values are found, purely due to random correlations. This was avoided by computing correlations with both $p<.05$ as well as $p<.01$. Further, correlations between two variables were compared with their temporal co-occurrence in a temporal pattern, and only those pairs of variables which were correlated as well as co-occurred in real-time were selected for further analysis. Hence randomly occurring correlations could be avoided, thus avoiding Type I error.

6.4 T-pattern Analysis

T-pattern analysis was carried out to search for significantly recurring patterns of private and social speech and goal-directed behaviours in the two goal-sharing contexts. The same categories of data between which correlational coefficients were calculated were also present in the data for the t-pattern search. This included the nine *pragmatic categories*, as well as the three categories of *goal-related behaviours,* namely*, goal-directed behaviours* (GDB)*, goal-mapping behaviours* (GMB) and *goal-relevant events* (GRE). For each goal-sharing context, the data for all the observations were merged into a single dataset. Hence patterns were searched across the entire dataset, rather than within individual observations of the children. The following search parameters were used to initiate the pattern search algorithm: **minimum occurrences** (minimum number of times a t-pattern must occur to be detected) = 10, **significance level** (maximum accepted probability of any critical interval relationship to occur by chance) = 0.005 and **minimum samples** (percent of samples or observations in which a pattern must occur to be detected) = 20%.

Events in a t-pattern search refer to all the datapoint on the timeline from which significantly recurring t-patterns are extracted. In this study, events refer to all the speech and behavioural events recorded in the study. The total number of events (comprising both speech and behavioural events) in each of the goal conditions as well as total number of unique t-patterns detected in each goal condition are shown below in **Table 6.1**. Number of private and social speech events within each goal condition are also reported in the table. From the total number of patterns detected in each condition, a fraction of them contained speech as one of the events. These were termed as *speech patterns*. The number of unique speech patterns in the two conditions are also reported in **Table 6.1**, tabulated separately as private and social speech patterns.

Table 6.1 Results of the t-pattern search across I_goal and we_goal episodes. **Events** refer to all the datapoint on the timeline of an episode, while **patterns** refer to the t-patterns detected from the timeline of events, and **speech patterns** refer to t-patterns containing at least one speech utterance as an event.

	I_goal		we_goal	
# of events	1879		2073	
# of unique patterns	810		987	
pattern/event ratio (all patterns)	0.43		0.47	
	Private	Social	Private	Social
# of speech events	139	302	148	473
# of unique speech patterns	15	85	28	354
pattern/event ratio (speech patterns)	0.11	0.28	0.19	0.74

A dataset with a higher degree of temporal organisation between its events would yield a larger number of unique t-patterns for the same number of events, when compared to a dataset with a lower degree of temporal organisation. A randomly organised dataset with no temporal relationship between its events would yield a negligible number of unique t-patterns. Hence a metric of *pattern/ event ratio* would indicate the degree of temporal organisation present in the dataset. The pattern / event ratio for all types of patterns (comprising both speech patterns and non-speech patterns) do not differ significantly across the two goal conditions (I_goal: 0.43; we_goal : 0.47), as reported in the **Table 6.1**.

Hence while looking at overall behaviour, the two conditions do not differ significantly in terms of temporal organisation between their events. However, the pattern/event ratio reported for speech patterns only, do reveal differences in temporal organisation between the two conditions, particularly for social speech (I_goal_social: 0.28; we_goal_social: 0.74). The ratios for private speech between the two conditions do not differ significantly (I_goal_private: 0.11; we_goal_private: 0.19). Hence, children in an episode governed by a shared goal, seemed to express a more patterned ways of using social speech with goal-related behaviours than in an episode governed by a personal goal. Further analysis of the data revealed below a more detailed picture of the type of patterned behaviours expressed in the two goal conditions. The various *pragmatic categories of speech* which co-occur with specific goal-related behaviours in the detected

speech patterns, for each of the four speech-goal conditions are tabulated in **Table 1, 2, 3** and **4**, respectively, in **Appendix H.**

Thus, correlations between speech and behaviour categories were computed for all the four speech-goal conditions (refer to correlational data in **Appendix G, Table 1, 2, 3 & 4)** and temporal co-occurrences between speech and behaviour categories appearing together in t-patterns were identified (refer to co-occurrence data in **Appendix H, Table 1, 2, 3 & 4).** The correlational and co-occurrence data for each of the four speech-goal conditions were then compared, to reveal three types of speech-behaviour pairs. The first type of speech-behaviour pairs were significantly correlated to each other but did not co-occur in t-patterns. These pairs fulfilled the condition of *correlation without co-occurrence.* The second type of speech-behaviour pairs were no significantly correlated, but occurred together in t-patterns. These pairs fulfilled the condition of *co-occurrence without correlation.* The final type of speech-behaviour pairs were both significantly correlated as well as co-occurred together in t-patterns, fulfilled the condition of *correlation with co-occurrence.* Speech-behaviour pairs appearing in each of the three conditions are presented below, along with an interpretation of the type of temporal relation indicated by each condition.

6.5 Correlation without Co-occurrence

When analysing the correlations and co-occurrences within t-patterns between speech and behavioural categories, it was evident that some behavioural categories correlated with certain *pragmatic categories of speech* but did not occur with them in t-patterns. This might point towards the first explanation of correlation found between speech and behavioural measures found in previous studies, which indicates that either those speech-behaviour pairs which correlated but did not co-occur were mediated by a third factor in the goal-directed episodes of the children or that speech might be influencing behaviour through a mechanism which was not evident in real-time and might be operating on a longer timescale. In either case, such speech-behaviour pairs indicated that not all correlations between speech and behaviour point towards a real-time mediation of behaviour, and need to be investigated using other methodologies which either look at mechanisms operating over a longer timescale or involve other hidden factors that might be mediating the reported correlation between these speech-behaviour pairs.

It may be noted here that the Spearman's rank correlations were computed between specific pairs with a significance of $p < .05$ and $p < .01$. However the search algorithm for the t-pattern search fol-

lowed a more rigorous statistical criteria by looking for a fixed temporal relation with a significance of p<.005 between each pair of events recursively, in order to detect the t-patterns in an episode. This is the recommended level of significance used by the Theme® software that computes the t-pattern search, in order to limit the influence of random events that may add noise to the search. Hence it might be possible that with a larger dataset with a greater number of occurrences per event, some of these correlated speech-behavioural pairs would also be detected in the t-patterns. Since each of the individual *pragmatic categories of speech* were not very frequent, for the purpose of increasing the strength of the search, another t-pattern search was carried out with all the *pragmatic categories of speech* merged into overall categories of *private* and *social speech*. Hence the second t-pattern search conducted only with overall speech category in its dataset (by merging the nine pragmatic categories) was labelled as the *robust t-pattern search*, compared to the *sensitive t-pattern search (*conducted with the nine pragmatic categories as separate). The search parameters for the search algorithm remained the same as in the previous search.

6.5.1 Comparing correlated pairs with sensitive t-pattern search

At the first stage of examining correlation without co-occurrence, significantly high correlations between behavioural categories and the nine *pragmatic categories of speech* (at p < .01) were compared with co-occurrences obtained through the *sensitive t-pattern search.* Those speech-behaviour pairs which were highly correlated but did not co-occur in any speech patterns are highlighted in light red under the column 'Correlation only (sensitive)' for the four speech-goal conditions in the **Table 6.2, 6.3, 6.4 & 6.5** respectively.

a) Ps_I_goal condition:

Goal-related behaviours	Correlation only (sensitive)	Correlation only (robust)	Co-occurrence only (sensitive)	Co-occurrence only (robust)	Correlation & Co-occurrence (robust)	Correlation & Co-occurrence (sensitive)
CHANGE	emotive		informative			indistinct
REPEAT	evaluative					
ROUTINE			directive			indistinct
SEARCH	informative, indistinct					
CHECK	evaluative, emotive					indistinct
NOTICE	indistinct					
REGULATE						
ATTAIN_G						
FAIL_G						
FAIL_STR						
DISTRACT	indistinct , other					
DISRUPT	directive, emotive					
FACILITATE	repetitive					
REGULATED	repetitive, indistinct					
SEEK HELP						
FOCUS_A	directive					
WANDER	informative					
LEAVE_G	indistinct					
NEW_G			informative, indistinct			
RETURN_G	informative, repetitive, indistinct					

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

b) Ps_we_goal condition:

Table 6.3. Comparing the correlation (at p<.01) with co-occurrence in a t-pattern of **private speech** and goal-related behaviours within the **we_goal context** (ps_we_goal). Comparisons made with two types of t-pattern search - 'sensitive' (nine pragmatic categories of speech as separate) and 'robust '(the nine pragmatic categories merged as overall speech). Particular pragmatic categories of speech are mentioned in the 'sensitive' condition. Black-coloured cells denote no correlation or co-occurrence.

Goal-related behaviours	Correlation only (sensitive)	Correlation only (robust)	Co-occurrence only (sensitive)	Co-occurrence only (robust)	Correlation & Co-occurrence (robust)	Correlation & Co-occurrence (sensitive)
CHANGE	directive, emotive					informative, indistinct
REPEAT	emotive					
ROUTINE	directive					informative, other
SEARCH	informative					
CHECK	directive					
NOTICE						informative, other
REGULATE	informative					
ATTAIN_G						
FAIL_G						
FAIL_STR	indistinct					
DISTRACT	informative, indistinct , other					
DISRUPT	directive, emotive, indistinct					
FACILITATE						
REGULATED	directive, informative, indistinct					
SEEK HELP						
FOCUS_A	directive, informative, other					
WANDER	informative					
LEAVE_G	other					
NEW_G						
RETURN_G	informative, emotive					

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

c) Soc_I_goal condition:

Table 6.4. Comparing the correlation (at p<.01) with co-occurrence in a t-pattern of social speech and goal-related behaviours within the I_goal context (soc_I_goal). Comparisons made with two types of t-pattern search - 'sensitive' (nine pragmatic categories of speech as separate) and 'robust '(the nine pragmatic categories merged as overall speech). Particular pragmatic categories of speech mentioned in the 'sensitive' condition. Cells coloured black denote no correlation or co-occurrence.

Goal-related behaviours	Correlation only (sensitive)	Correlation only (robust)	Co-occurrence only (sensitive)	Co-occurrence only (robust)	Correlation & Co-occurrence (robust)	Correlation & Co-occurrence (sensitive)
CHANGE			directive, informative	*(blue)*		
REPEAT						
ROUTINE			directive, indistinct			
SEARCH	indistinct					
CHECK			indistinct			
NOTICE	indistinct		directive, informative			
REGULATE	agree/disagree				*(green)*	directive, informative
ATTAIN_G			indistinct		*(green)*	directive, informative, agree/disagree
FAIL_G	directive, informative, agree/disagree, emotive				*(green)*	
FAIL_STR					*(green)*	directive, informative
DISTRACT	*(black)*	*(black)*	*(black)*	*(black)*	*(black)*	*(black)*
DISRUPT	*(black)*	*(black)*	*(black)*	*(black)*	*(black)*	*(black)*
FACILITATE	informative, agree/disagree				*(green)*	directive, indistinct
REGULATED	agree/disagree, indistinct				*(green)*	directive, informative
SEEK HELP	emotive	*(red)*				
FOCUS_A	informative, evaluative				*(green)*	directive
WANDER	indistinct					
LEAVE_G					*(green)*	directive
NEW_G			directive, agree/disagree, indistinct		*(green)*	informative
RETURN_G	emotive					

- CHANGE = change strategy*;* REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

d) Soc_we_goal condition:

Table 6.5. Comparing the correlation (at p<.01) with co-occurrence in a t-pattern of **social speech** and goal-related behaviours within the **we_goal context** (soc_we_goal). Comparisons made with two types of t-pattern search - 'sensitive' (nine pragmatic categories of speech as separate) and 'robust '(the nine pragmatic categories merged as overall speech). Particular pragmatic categories of speech are mentioned in the 'sensitive' condition. Black-coloured cells denote no correlation or co-occurrence

Goal-related behaviours	Correlation only (sensitive)	Correlation only (robust)	Co-occurrence only (sensitive)	Co-occurrence only (robust)	Correlation & Co-occurrence (robust)	Correlation & Co-occurrence (sensitive)
CHANGE	emotive					directive, informative, evaluative, agree/disagree, indistinct
REPEAT	directive, evaluative					
ROUTINE	emotive					directive, informative, evaluative, agree/disagree, indistinct
SEARCH	directive, agree/disagree, other					informative, indistinct
CHECK	evaluative		informative			directive
NOTICE	agree/disagree, emotive, evaluative					directive, informative
REGULATE	agree/disagree					directive, informative
ATTAIN_G	seek/respond					directive, informative
FAIL_G						
FAIL_STR	emotive, evaluative, informative					directive, indistinct
DISTRACT	directive, informative, agree/disagree, emotive, indistinct , evaluative					
DISRUPT			informative			evaluative, indistinct
FACILITATE	directive, informative, repetitive					
REGULATED	agree/disagree, emotive, seek/respond, indistinct					directive, informative
SEEK HELP	evaluative					
FOCUS_A	directive, agree/disagree, emotive, evaluative, indistinct					

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Goal-related behaviours	Correlation only (sensitive)	Correlation only (robust)	Co-occurrence only (sensitive)	Co-occurrence only (robust)	Correlation & Co-occurrence (robust)	Correlation & Co-occurrence (sensitive)
WANDER	informative, agree/disagree, repetitive, indistinct					
LEAVE_G	informative, repetitive, indistinct					
NEW_G						directive, informative
RETURN_G	agree/disagree, emotive, indistinct , evaluative					informative

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

6.5.2 Comparing correlated pairs with robust t-pattern search

The speech patterns obtained through the *robust t-pattern search* comprised a wider range of behavioural categories than the previous search, as was expected. At the second stage of examining correlation without co-occurrence, significantly high correlations between behavioural categories and rates of production of overall speech (at $p < .01$) were compared with co-occurrences obtained through the *robust t-pattern search.* Those behavioural categories which still showed a correlation with the overall speech measure but did not co-occur in any speech patterns are highlighted in dark red under the column 'Correlation only (robust)' for the four speech-goal conditions in the **Tables 6.2, 6.3, 6.4 & 6.5**, respectively. For ease of reference, the cells highlighted in dark red in these tables are compiled together for all the four speech-goal conditions in **Table 6.6** below, depicting goal-related behaviours which revealed *correlation without co-occurrence*, even within the robust t-pattern search.

Table 6.6 **Correlation without co-occurrence** of goal-related behaviours with overall private and social speech utterances within the robust t-pattern search

speech-goal conditions

Goal-related behaviours	ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
Distraction	🟥	🟥		
Return to previous goal	🟥	🟥		
Regulate others		🟥		
Regulated by others	🟥			
Start focused act		🟥		
Seek help			🟥	
Facilitated by other		🟥		

6.5.3 Interpretation of correlation without co-occurrence

Hence, it may be said with more confidence that the correlation without co-occurrence of the particular behavioural categories with overall speech (refer to **Table 6.6**), may be pointing towards some mechanism, other than real-time verbal mediation, operating on a longer timescale or involving other mediating factors. For example, a strong correlation of the measure of *distraction* with overall private speech in both the I and we_goal conditions might indicate the possibility of a relation between a trait such as distractibility and overall private speech production, rather than the real-time co-occurrence of the event of distraction with a private speech utterance. It may be noted that this type of temporal relation was predominantly seen for private speech rather than social speech conditions (only one speech-behaviour pair involving *seek help* in the soc_I_goal condition).

However, it might be too simplistic to take up an individual event as an indicator of a trait. This has been argued later in **Section 7.3.1.6** of **Chapter 7**, where self-regulation scores were calculated for each child while investigating the individual differences in the styles of verbal mediation of behaviour. Here, instances of successes and failures of self-regulation were identified as a particular sequence of behaviours, wherein the same event appeared in a sequence of successful self-regulation and in a sequence of failure of self-regulation, depending upon the other events adjacent to it.

Further analysis of such speech-behaviour correlations, representing possible traits rather than real-time verbal meditation, was not possible due to the small number of children examined within the scope of this doctoral project.

6.6 Co-occurrence without Correlation

The sensitive t-pattern search (with separate pragmatic categories of speech) as well as the robust t-pattern search (with all pragmatic categories combined into overall speech measures), revealed certain instances of co-occurrence of a speech and a behavioural category in a t-pattern, which were not otherwise significantly correlated. They are highlighted under the column 'Co-occurrence only (sensitive)' in light blue and under the column 'Co-occurrence only (robust)' in dark blue in the **Tables 6.2, 6.3, 6.4 and 6.5,** for each of the four speech-goal conditions, respectively. For ease of reference, the cells highlighted in dark blue in these tables are again complied together in **Table 6.7** for the four speech-goal conditions, depicting those goal-related behaviours which co-occurred with private or social speech in the more robust t-pattern search, but did not correlate even at a lower significance level of p<.05.

Table 6.7 Co-occurrence without correlation of goal-related behaviours with overall private and social speech utterances within the robust t-pattern search

	speech-goal conditions			
Goal-related behaviours	ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
New goal pursuit	██	██		
Goal attained	██			
Change strategy			██	

6.6.1 Interpretation of co-occurrence without correlation

While co-occurrence of events without any correlation might be difficult to explain as a behavioural phenomenon in the recorded data, a statistical explanation for such a result can be gleaned from similar methods employed in another field of research, namely animal ecology. Spatial patterns of species co-occurrence are examined in ecological data to identify possible ecological interactions between species such as predation, parasitism, etc. Two common types of detection error reported by these studies are Type I errors or *false presences* and Type II errors or *false absences*. Some species will be always detected in a location because they may be very conspicuous or ubiquitously present, and hence may have a disproportionately higher presence or 'false presence' in a spatial pattern. Some species, on the other hand, might be very difficult to detect, even when present in a location, and hence they may be under-represented in a spatial pattern, leading to 'false absences' (MacKenzie, Bailey & Nichols, 2004; Waddle *et al.,* 2010).

A parallel can be drawn with the events occurring in a temporal pattern in the present study. Some events, due to their ubiquitous nature in a goal-directed episode, may be over-represented in a temporal pattern, while others might not be detected in a pattern due to their rare occurrence in the episode. In the results obtained, the phenomenon of some behavioural categories co-occurring with speech in t-patterns but not showing any correlation might be an example of false presence, i.e., an over-representation of those behavioural events in the episode, due to which they are detected in a t-pattern.

The above-mentioned ecological studies suggest two solutions for these detection errors (Waddle *et al.,* 2010). In cases of false absences, where data points are difficult to record for whatever reason, higher sample sizes are needed to effectively detect such data points. This has already been

suggested in **Section 6.5** above, wherein behavioural events showing high correlation with certain speech categories but not co-occurring with these speech categories in any t-pattern, might be a case of false absence, due to the small frequency of individual speech categories. A larger dataset with more instances of speech events recorded from a larger group of children might be able to overcome this type of detection error in a future study. In the instances of false presences or Type I errors, the over-representation of certain data points (species or events) can be accounted for when patterns containing such data points are interpreted in their given contexts. In the present study, the false presence of patterns involving the behavioural events highlighted in **Table 6.7** can be explained by the specific context of the speech and goal conditions in which they were recorded.

In both the I_goal and we_goal contexts, *new goal pursuit* was recorded for every goal-oriented episode where a new goal was pursued by the child, hence making it one of the most frequent events to be recorded in an episode. However in the t-pattern search, the less frequent occurrence of private speech compared to social speech meant that *new goal pursuit* was overrepresented in comparison to private speech utterances in the ps_I_goal and ps_we_goal conditions. This could explain the co-occurrence of *new goal pursuit* with overall private speech in both the goal conditions, despite not showing any significant correlation with the overall private speech measure.

The presence of *goal attained* in the ps_I_goal but not in the ps_we_goal condition can be explained by the specific nature of goals pursued in the two goal conditions. In the I_goal condition, the goals pursued were personal, involved a single agent and were mostly closed-ended in nature (For e.g., tidying-up a play-area, attaining mastery over particular play-objects, individual craft-making, etc.) In comparison, the goals pursued in the we_goal condition were shared with other agents, and were usually more open-ended in nature (For e.g., enacting and extending an evolving script in pretend play with multiple players, building a joint model in constructional play, etc.). Hence, with lesser interruptions and changes to a goal made in the I_goal compared to the we_goal condition, attainment of the goal was more frequently recorded in the former (79 *goal attained* events in the I_goal condition compared to 61 *goal attained* events in the we_goal condition). This could also explain the significantly strong negative correlation between overall private speech and *goal attained* in the ps_I_goal condition, as reported in **Chapter 5** (**Section 5.3.1**).

The presence of *change strategy* in co-occurrence patterns with social speech in the I_goal condition can again be explained by the highly frequent occurrence of changes in an existing strategy, that were more possible in personal goals than shared goals. Again, this could explain the

strong negative correlation between overall social speech and *change strategy* in the soc_I_goal condition, as reported in **Chapter 5** (**Section 5.3.2**). However in all other speech and goal conditions, *change strategy* co-occurred as well as correlated with speech utterances, thereby indicating real-time verbal mediation in these contexts (Refer to the cells under the column 'Correlation & Co-occurrence (sensitive)' highlighted in light green in **Tables 6.3, 6.4** and **6.5**).

6.7 Correlation with Co-occurrence

The final condition under which task-relevant speech utterances and goal-related behaviours may be associated with each other is the correlation of the speech-behaviour pairs as well as their co-occurrence within t-patterns. Hence, *correlation with co-occurrence* would be a necessary (if not sufficient) condition for assuming real time verbal mediation of behaviour. Further contextual analysis of the speech-behaviour pairs that fulfil the condition of *correlation with co-occurrence*, might reveal the various behavioural functions that speech may be mediating in real time. This would be the final and sufficient condition for proving the presence of verbal mediation of behaviour within any temporal relation between speech and behaviour.

Before presenting the results obtained in the study under the condition of *correlation with co-occurrence* and the possible functions of speech that they may indicate, the Contextual Model of Verbal Mediation and its predictions regarding the various context-based functions of speech, will be briefly presented again. Since the overarching context in this study was determined by the goal-sharing nature (I_goal or we_goal) of a goal-directed episode, the context-based speech functions predicted by the Contextual Model will be presented under the four speech-goal conditions. The results obtained in the study will then be compared with the predictions made by the Contextual Model, in order to confirm the validity of the model, and meaningfully interpret the results obtained.

6.7.1 Predictions of the Contextual Model of Verbal Mediation

The Contextual Model of Verbal Mediation (proposed in **Section 2.5.2.3** of **Chapter 2**) proposed that both *forms of speech*, private as well as social speech, may be temporally related with relevant behaviour in two ways, namely*, preceding* or *following* the behaviour, depending on the *timing of speech*. The appearance of speech before relevant behaviour would indicate the function of *verbal control* upon the subsequent relevant behaviour, while the appearance of speech after relevant behaviour would indicate the function of *verbal commentary* based on the preceding relevant behaviour, which may in turn mediate subsequent behaviour. Hence, *verbal control* and *verbal commentary* can be considered as mutually interacting processes of verbal mediation of behaviour, operating in tandem throughout an episode of verbal mediation, just like the cyclical processes of *control* and *monitoring* proposed by the Nelson and Narens' model (1990, refer to **Section 2.4.4** for a detailed description of the model). Verbal mediation may be achieved through speech, by acting on either *sites of action,* i.e. the self or other. The *means of action* by which the mediation of behaviour may be achieved can either be a *process* (through the 'act of saying') or a *product* (through appropriating the meaning of 'what is said'). For ease of reference, the model is reproduced below in a pictorial form in **Fig. 6.1,** showing the eight speech profiles, i.e., the eight combinations (A-H) of the two *forms* and *timings of speech* as well as the two *sites* and *means of action*.

In this study, the broader goal-sharing context, as well as the more particular goal of an activity determined the speech profile which would be exhibited by the children. The speech profiles which might be observed and the possible functions that they may fulfil in the four speech-goal conditions, as predicted by the Contextual Model are described below.

Contextual Model of Verbal Mediation

Figure 6.1 Pictorial depiction of the *Contextual Model of Verbal Mediation*, showing the eight possible speech profiles (A-H) - combinations of *form of speech,* (private or social speech), *timing of speech* (preceding or following), *site of action of speech* (self or other) and *means of action* (process or product).

6.7.1.1 I_goal context

Conditions where a child is pursuing a personal goal (I_goal), for which the child alone is making efforts to attain it, any goal-directed regulation of behaviour would be directed at oneself, and not at others. Hence task-relevant private speech in the I_goal context would be used for goal-directed regulation of own behaviour. However, in the study, all I_goal episodes were observed when the child was in the presence of others, in order to rule out the effect of the social presence of others in the type of speech use in conjunction with behaviour. Hence in the I_goal context, task-relevant social speech may still be used for communicating with others regarding other issues related to the task, but not for goal-directed regulation of others' behaviour towards the goal of the task.

Hence, task-relevant private speech in the I_goal context (ps_I_goal) may be used for instructing or guiding oneself, as it occurs in conjunction with goal-directed control strategies. This would represent the process of *verbal control,* where speech precedes the relevant goal-directed behaviour. According to the Contextual Model of Verbal Mediation, the **Type A** speech profile (private_preceding_self_process) would be commonly exhibited in such contexts. Private speech may also be used in this context to verbalise goal-relevant information for the self. This would be commonly seen in conjunction with goal-directed monitoring strategies, wherein speech would follow a monitoring behaviour and verbally articulate the results of the monitoring process, by announcing the detected error, or evaluation of the task progress, task difficulty or one's own ability or performance, etc. This would represent the process of *verbal commentary*, where speech follows the relevant behaviour and would be exemplified by the **Type B** speech profile (private_following_self_process). Thus, both speech functions, namely, *verbal control* and *verbal commentary* would together fulfil the broader contextual function of *goal-directed regulation of own behaviour* in the I_goal context. Hence the speech profiles appearing in this context would involve private speech acting directly on the *self* through the *process* of speech as shown by the **Type A** (private_preceding_self_process) and **Type B** (private_following_self_process) speech profiles.

In this context, task-relevant social speech (soc_I_goal) may be used for communicating with others for managing situations when others intervene in one's activity (positively or negatively) or for informing others about the progress of one's activity, such as after instances of failure, attainment of goal, or events that mark the beginning or end of one's goal pursuit. In both the situations (*communication for managing situations* and *communication for informing others*), speech may

precede the relevant behaviour to announce the upcoming behaviour or be produced after the relevant behaviour or event in order to report or respond to the new changes. Hence social speech with the *timing of speech* as *preceding* as well as *following* the relevant behaviour, would be produced in this context. Thus, according to the Contextual Model, both **Type C**(social_preceding_other_process) and **Type D** (social_following_other_process) social speech profile would be commonly produced in such scenarios, aimed at others.

Hence the contextual functions of *goal-directed regulation of own behaviour, communication for managing situations* and *communication for informing others* would be fulfilled by private and social speech in this condition, as shown by the **Type A, B** (private) and **Type C & D** (social) speech profiles.

6.7.1.2 We_goal context

In conditions where a child is pursuing a shared goal in a group (we_goal), for which the child is jointly making efforts to attain the goal with others, goal-directed regulation of behaviour would be directed both at oneself, and at others. Hence task-relevant private speech in the we_goal context would be directly used for *goal-directed regulation of own behaviour*. However private speech (ps_we_goal) may also indirectly influence others, when the others sharing the same goal appropriate the meaning of 'what is said', thus fulfilling the contextual function of *goal-directed regulation of others' behaviour*. Hence the same private speech utterance that is meant for the self may also indirectly act upon others as a verbal *product*. Hence in addition to the **Type A** and **Type B** private speech profiles which were also present in the I_goal context, **Type E** (private_preceding_other_product) and **Type F** (private_following_others_product) speech profiles may also be found in this context. **Type E** and **Type F** speech profiles are analogous to the **Type A** (private_preceding_self_process) and **Type B** (private_following_self_process) speech profiles, respectively, except that they indirectly act upon others, as *products* and not as *processes*. Hence the contextual function of *goal-directed regulation of behaviour* would be fulfilled by private speech in this condition. However, due to the shared nature of the goal, both *goal-directed regulation of own behaviour* and *goal-directed regulation of others' behaviour* involved in the shared goal would take place through the **Type A, B, E** and **F** private speech profiles.

Task-relevant social speech (soc_we_goal) in the shared goal condition may be used for the same purposes as social speech in the personal goal condition (soc_I_goal), i.e., for managing situations created by others as well as informing others about the progress of the joint activity. Hence **Type C**

and **Type D** speech profiles would also be present in this condition, just like in the soc_I_goal condition. However, an additional purpose of social speech in this condition can be the direct *goal-directed regulation of others' behaviour* towards the attainment of the shared goal. This would be represented by the **Type C** (social_preceding_other_process) and **Type D** (social_following_other_process) speech profiles, fulfilling the functions of *verbal control & verbal commentary* of others' behaviour, respectively. Moreover, social speech meant for others may also act indirectly as a *product* and regulate the child's own behaviour within a shared goal. These would be represented by the **Type G** (social_preceding_self_product) and **Type H** (social_following_self_product) speech profiles.

Hence the contextual functions of *communication for managing situations, communication for informing others* and *goal-directed regulation of own behaviour* and *goal-directed regulation of others' behaviour* towards a shared goal would be fulfilled by private and social speech in this condition, as shown by the **Type A, B, E & F** (private) and **Type C, D, G & H** (social) speech profiles.

6.7.1.3 Contextual functions of speech

Hence, three types of contextual functions, namely, *goal-directed regulation of behaviour* (*self & other*)*, communication for managing situations* and *communication for informing others* emerged from the predictions made by the model above. Private speech in both the I_goal and the we_goal contexts may perform *goal-directed regulation of own behaviour* for regulating oneself directly, and *goal-directed regulation of others' behaviour* for regulating others indirectly in the we_goal. Moreover, social speech in the we_goal contexts may also perform the function of *goal-directed regulation of others' behaviour,* albeit for directly regulating others towards the shared goal. Social speech produced in the I-goal context would not be required for performing goal-directed regulation for others, due to the personal nature of the goal. On the other hand, social speech in both the goal contexts may perform the functions - *communication for managing situations* and *communication for informing others.* **Fig. 6.2** recapitulates the various contextual functions proposed above, according to the type of speech and goal condition, and the type of speech profiles that may be found in each condition.
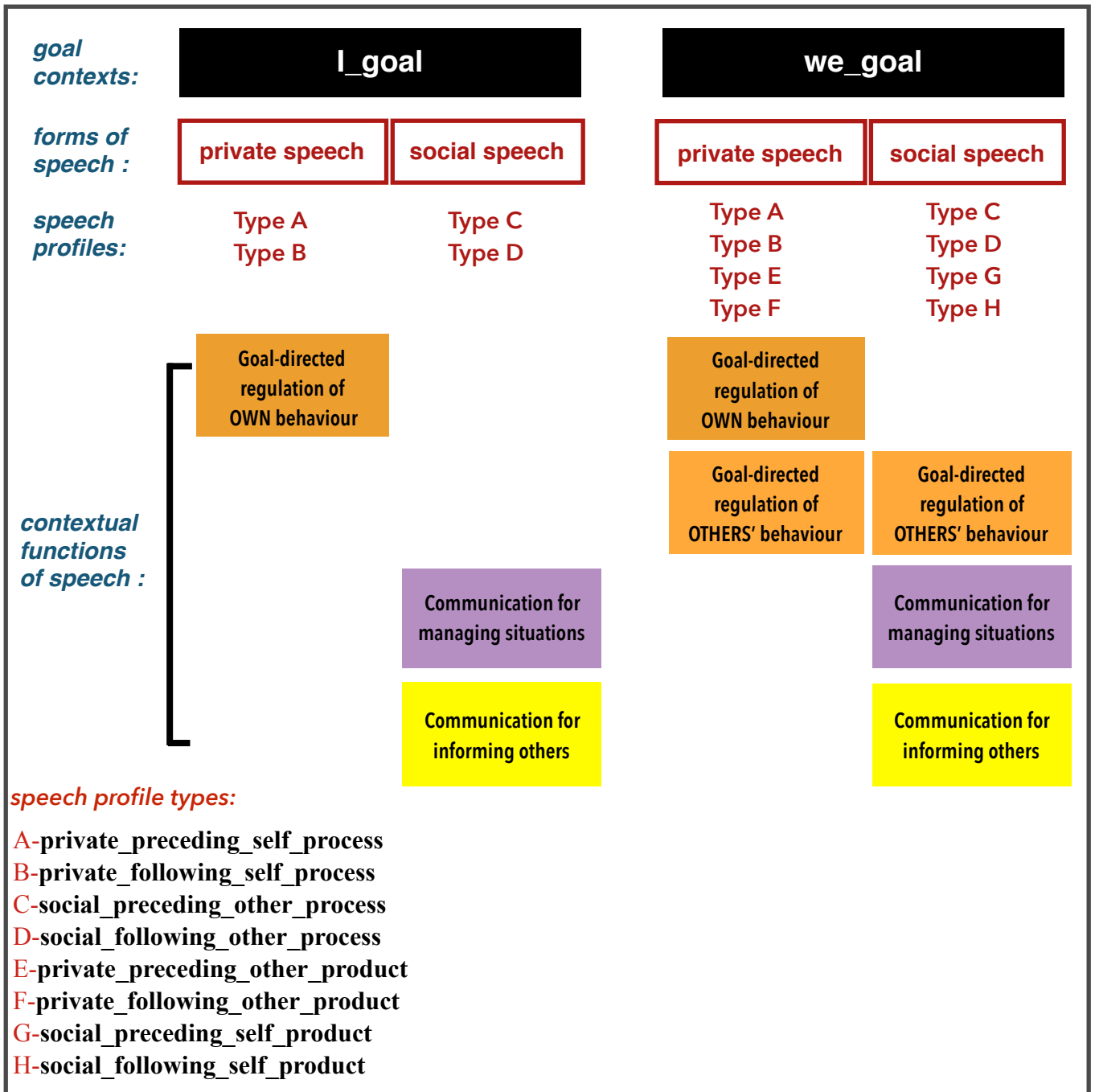
Figure 6.2 Visual depiction of the three contextual functions of speech (in orange, purple and yellow coloured bubbles) for private and social speech in the I_goal and we_goal contexts, predicted by the Contextual Model of Verbal Mediation, along with the speech profiles predicted by the model, to be found in each context .

6.7.2 Correlation and Co-occurrence : results of the study

The comparison of correlations and co-occurrences between speech and behaviours in the study finally revealed those goal-related behaviours which showed significant correlation ($p < .05$) with certain pragmatic categories of speech as well as co-occurring with these speech categories in t-patterns obtained through the sensitive t-pattern search. These speech-behaviour pairs are reported under the column 'Correlation & Co-occurrence (sensitive)' and highlighted in light green in **Tables 6.2, 6.3, 6.4** and **6.5** for each of the four speech-goal conditions, respectively. For ease of reference, they are all tabulated together, for the four speech-goal conditions in **Table 6.8** given below.

Upon examining the various goal-related behaviours in the table that correlated and co-occurred with the pragmatic speech categories, it was evident that for a group of behavioural categories, the correlation and co-occurrence condition was valid for all except the **soc_I_goal** condition. Each of the goal-related categories in this group belonged to the category of *goal-directed behaviour*, and was either a goal-directed control (*change, routine* and *search strategy*) or monitoring strategy (*check progress* and *notice error/issue*). These categories have been highlighted in orange in **Table 6.8.** All other behavioural categories correlated and co-occurred with speech categories in the **social_I_goal** and **soc_we_goal** conditions only. Of these, three of the behavioural categories were all related to the positive or negative involvement of others in the activity (*regulate others, facilitated by other* and *regulated by other*), and seemed to present occasions for dealing with the involvement of others during the goal-directed episode. These categories have been highlighted in purple in **Table 6.8.** The rest of the categories were either *goal-relevant events* (*disruption, failed strategy* and *goal attained*) or *goal-mapping behaviours* (*new goal pursuit, return to previous goal, leave goal pursuit* and *start focused activity*) which were not directly related to goal-attainment. The goal-relevant events presented occasions related to events of failure or success during goal-attainment, while the goal-mapping behaviours presented occasions marking the beginning or end of a task-episode. Hence all of these events and behaviours seemed to present occasions for informing others about these goal-related happenings in the **soc_I_goal** and **soc_we_goal** conditions. These categories have been highlighted in yellow in **Table 6.8.**

Table 6.8 Correlation with Co-occurrence, with the sensitive t-pattern search involving co-occurrences of pragmatic categories of speech and goal-related behaviours and their correlations at p<.01, for each of the four speech-goal conditions. The goal-related behaviours are colour-coded, according to the different contextual functions of speech that they may be involved in.

Contextual functions	Goal-related behaviours	speech-goal conditions			
		ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
Goal-directed regulation of behaviour (self and others)	**Change strategy**	indistinct	informative, indistinct		directive, informative, evaluative, agree/disagree, indistinct
	Routine strategy	indistinct	informative, other		directive, informative, evaluative, agree/disagree, indistinct
	Search strategy				informative, indistinct
	Check progress	indistinct			directive
	Notice error/issue		informative, other		directive, informative
Communication for managing situations	**Regulate others**			directive, informative	directive, informative
	Facilitated by other			directive, indistinct	
	Regulated by other			directive, informative	directive, informative
Communication for informing others	**Disruption**				evaluative, indistinct
	Failed strategy			directive, informative	directive, indistinct
	Goal attained			directive, informative, agree/disagree	directive, informative
	New goal pursuit			informative	directive, informative
	Return to previous goal				informative
	Leave goal pursuit			directive	
	Start focused activity			directive	

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The *pragmatic categories of speech* in these patterns occur both before as well as after the various behavioural categories. Going back to the scenarios of temporal co-occurrences discussed in **Section 6.2** at the beginning of the chapter, since there is no absolute occurrence of all speech before behaviour (scenario 1) or all speech after behaviour (scenario 2), scenario 3 (a mix of scenario 1 and 2) seems to be the most suitable description of the results reported in **Table 6.8,** as the phenomenon of c*orrelation with co-occurrence*. Hence real-time verbal mediation of behaviour, as represented by the speech-behaviour pairs obtained, seem to comprise both *verbal control* (wherein speech occurs before goal-related behavioural events) as well as *verbal commentary* (wherein speech occurs after goal-related behavioural events).

6.7.3 Comparisons of Results with Contextual Model of Verbal Mediation

A comparison of the results obtained under the category of *correlation with co-occurrence* (shown in **Table 6.8)** with the predictions of contextual functions of speech made by the Contextual Model (shown in **Fig. 6.2,** refer to **Section 6.7.1)**, seems to corroborate the claims made by the model. A detailed analysis of the nature of co-occurrence of the specific groups of goal-related behaviours (highlighted in **Table 6.8** in orange, purple and yellow**)**, with speech in each of the speech-goal conditions reveals the similarities with the proposed contextual functions. Comparison of the results with each of the three contextual functions, namely, *goal-directed regulation of behaviour (self & other), communication for managing situations* and *communication for managing others,* is described in the sections below. The presence of the specific speech profiles predicted by the model (refer to **Fig. 6.2**) under the various speech-goal conditions in the study can only be confirmed by examining the actual context and temporal order of the speech and behaviour occurrences in real-time data. This is reported later in **Section 6.8**

6.7.3.1 Goal-directed regulation of behaviour

The behavioural categories highlighted in orange in **Table 6.8** represent those goal-directed strategies that were used by the children for the control (e.g., *change strategy, routine strategy, search strategy*) and monitoring (*check progress, notice error/issue*) of their own as well as others' behaviour during goal-attainment. For ease of reference, this section of **Table 6.8** is reproduced below in **Table 6.9.**

Table 6.9 Correlation with Co-occurrence for behavioural categories highlighted in orange, representing '**goal-directed regulation of behaviour (self & other)** (extracted from Table 6.8)

Contextual functions	Goal-related behaviours	speech-goal conditions			
		ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
Goal-directed regulation of behaviour (self & other)	**Change strategy**	indistinct	informative, indistinct		directive, informative, evaluative, agree/disagree, indistinct
	Routine strategy	indistinct	informative, other		directive, informative, evaluative, agree/disagree, indistinct
	Search strategy				informative, indistinct
	Check progress	indistinct			directive
	Notice error		informative, other		directive, informative

Behaviours in this group were found to co-occur with speech categories in the **ps_I_goal** and **ps_we_goal** conditions, indicating goal-directed regulation of one's own behaviour through private speech (refer to the columns labelled 'ps_I_goal' and 'ps_we_goal' in **Table 6.9**). Co-occurrence of these behaviours with speech was also found in the **soc_we_goal** condition, indicating goal-directed regulation of other's behaviour through social speech (refer to the column labelled 'soc_we_goal' in **Table 6.9**). Hence these results point towards *goal-directed regulation of behaviour* as a common function of both private and social speech, depending on the context, as predicted by the model above (refer to the contextual function in the orange box, listed below 'I_goals' and 'we_goals' in **Fig. 6.2**.). Moreover, this group of behaviours did not co-occur with any speech category in the **soc_I_goal** condition (refer to the empty column labelled 'soc_I_goal' in **Table 6.9**), which further supports the claim made by the contextual model that social speech was not employed for regulating others in an episode governed by a personal goal (refer to the absence of the contextual function *goal-directed regulation of behaviour* below 'I_goals' under the heading of 'social speech' in **Fig. 6.2**).

6.7.3.2 Communication for managing situations

The behavioural categories highlighted in purple in **Table 6.8** represent occasions for engagement with others, either when the focal child was engaged in the regulation of another child (e.g., *regulate others)* or when others intervened in the on-going activity, either through positive contributions (e.g., *facilitated by other)* or through negative interferences (e.g., *regulated by other).* For ease of reference, this section of **Table 6.8** is reproduced below in **Table 6.10**.

Table 6.10 Correlation with Co-occurrence for behavioural categories highlighted in purple, representing '**communication for managing others**' (extracted from Table 6.8)

Contextual functions	Goal-related behaviours	speech-goal conditions			
		ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
Communication for managing situations	Regulate others			directive, informative	directive, informative
	Facilitated by other			directive, indistinct	
	Regulated by other			directive, informative	directive, informative

During the observed classroom activities, these were usually occasions which either created confrontations when other children were regulated by the focal child (as in *regulate others)* or situations involving readjustment, failure or disappointment when the focal child was interrupted in any way by other children, either positively (as in *facilitated by other*) or negatively (as in *regulated by other*). Hence the social speech produced during these occasions, might have been employed in managing such arousing situations, either to avoid confrontation with others or to mitigate the impact of one's own experience of readjustment, failure or disappointment. The results confirmed the predictions made by the model, such that, behaviours falling under this group of behaviours co-occurred with social speech categories, both in the **soc_I_goal** and **soc_we_goal** conditions (refer to the columns labelled 'soc_I_goal' and 'soc_we_goal' in **Table 6.10**). Hence the results indicated that certain types of social speech produced by the children during the attainment of personal as well as shared goals might be used for communicating with others to manage an emotionally arousing situation during a goal-relevant interaction with others, as predicted by the contextual model (refer to the function in the purple box, listed below 'I_goals' and 'we_goals', under the heading of 'social speech' in **Fig. 6.2**.)

6.7.3.3 Communication for informing others

The behavioural categories highlighted in yellow in **Table 6.8** represent occasions for communication employed for informing others about the progress of the goal-oriented episode. For ease of reference, this section of **Table 6.8** is reproduced below in **Table 6.11**.

Table 6.11 Correlation with Co-occurrence for behavioural categories highlighted in yellow, representing 'communication for informing others' (extracted from Table 6.8)

Contextual functions	Goal-related behaviours	speech-goal conditions			
		ps_I_goal	ps_we_goal	soc_I_goal	soc_we_goal
Communication for informing others	Disruption				evaluative, indistinct
	Failed strategy			directive, informative	directive, indistinct
	Goal attained			directive, informative, agree/disagree	directive, informative
	New goal pursuit			informative	directive, informative
	Return to previous goal				informative
	Leave goal pursuit			directive	
	Start focused activity			directive	

During the recorded classroom activities, events such as *failed strategy* and *leave goal pursuit* presented occasions for informing others about any failure encountered in the ongoing activity. Hence the speech produced during such occasions might have been used for explaining and excusing one's behaviour for failure, communicating one's decision to leave further pursuit of the goal and informing others about any alternative future plans. Speech produced during such moments of difficulty may also have acted as an indirect plea for help from others. The event *goal attained* may have presented occasions for informing others about one's achievement and the state of progress of the ongoing activity, which would have been carried out through the speech co-occurring during such moments. Events such as *new goal pursuit, return to previous goal* and *start focused activity* marked the initiation or termination of a goal-oriented episode and may have

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presented occasions for informing others about one's further plan of action. The results again confirmed the predictions made by the model, such that, behaviours falling under this category co-occurred with social speech categories in the **soc_I_goal** and **soc_we_goal** conditions (refer to the columns labelled 'soc_I_goal' and 'soc_we_goal' in **Table 6.11**). This indicated that social speech produced during the personal and shared goal conditions were also used for communicative purposes, particularly to inform others about the developments and progress in the ongoing activity.

6.7.4 Need for contextual analysis of correlating and co-occurring pairs

The analyses carried out so far for the correlated and co-occurring speech-behaviour pairs, do indicate the presence of the various contextual functions of speech, as predicted by the Contextual Model of Verbal Mediation. However, the analyses still lack the details of the actual content of the speech produced and the behaviour exhibited during and around such moments of co-occurrence. Without access to these details, one cannot confirm the actual function being performed by speech with respect to behaviour, during such a situation, even though one may have established a recurring temporal relationship between the co-occurring speech and behaviour pair. Hence, it is imperative to look at the actual context in which such a co-occurrence of speech and behaviour is embedded, in order to confirm the various contextual functions that seem to be performed by private and social speech in the two goal-sharing contexts.

The phenomenon of correlating and co-occurring speech-behaviour pairs expressed in the naturalistic data also confirms the presence of real-time verbal mediation of behaviour. However it still does not provide us with the exact temporal order of speech and behaviour in the t-patterns from which they were selected. An in-depth contextual analysis of t-patterns from where these speech-behaviour pairs were extracted can reveal those instances when speech occurred before behaviour in a t-pattern, thus indicating verbal mediation in the form of *verbal control* (i.e., providing guidance or a prelude to the subsequent behaviour) and those instances when speech occurred after behaviour in a t-pattern, indicating verbal mediation in the form *verbal commentary* (i.e. narration or evaluation related to the preceding behaviour).

Moreover, the focus of the present study was the behaviour of the individual child during each goal-directed episode rather than the behaviour of others present in the context or the group as a whole. Hence, only the behaviours and speech produced by the focal child were processed for further analyses. However, by going back to those sections of the goal-directed episodes from which the t-

patterns were extracted, more information about the speech and goal-related behaviours of others present around the focal child and the details of the ongoing activity can be obtained. Hence a detailed contextual analysis of the t-patterns from which the speech-behaviour pairs were extracted, would further strengthen the claims made by the analyses conducted so far and attempt to fully answer the second research question by delineating the types of roles undertaken by task-relevant private and social speech in the real-time verbal mediation of behaviour in the two goal-sharing contexts. This has been reported in the next section.

6.8 Contextual analysis of t-patterns

Comprehensive information about the content, temporal order and overall context of speech and behaviour in a dataset such as the one recorded in the present study can only be gathered by a detailed contextual analysis of the actual recording in real-time. In a smaller dataset, this can be achieved by going through all the recorded events manually and selecting relevant portions of the data for a detailed qualitative analysis. Several studies, particularly in the area of research dealing with private speech and second-language acquisition, have followed this method (Ramirez, 1992; Smith, 2007), and argue for necessarily following a subjective method of interpretation for delineating the function of various utterances. Followers of this method also argue that each instance of a speech utterance is unique and a valid example on the basis of which a particular function of the utterance can be derived. However this method has not been taken up by most private speech researchers, for its particularly subjective nature of selection and interpretation. Another practical but equally valid limitation of this method of manual selection of relevant events and utterance is that it cannot be applied to a larger dataset. In such a case, contextually analyzing those instances of speech and behavioural events which are strongly correlated might be a more efficient and statistically objective method. However, as was seen in **Section 6.5**, correlations between speech and behaviour are not sufficient evidence for their actual co-occurrence in real-time data. Hence the distinct advantage of employing t-pattern analysis is to select relevant sections of data through a statistically rigorous search algorithm, which is still sensitive to the real-time temporal relations between speech and behaviour, unlike correlational analysis. Type I errors or false presence (when t-patterns pick up an event which is over-represented in a dataset) can be minimised by combining its results with correlational analysis, and only selecting those events which strongly correlate as well as co-occur (as was carried out in **Section 6.7**). Type II errors or false absence (when t-patterns fail to select those events which might be meaningful but are not

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very frequent in comparison to other events) can be minimised by increasing the size of the dataset, such that the frequency of the rare events are increased, thereby increasing their chances of being detected in a t-pattern search. This can also minimise Type I error by reducing the influence of the more ubiquitous events in comparison to the rare events in a t-pattern search, if their frequencies are made comparable.

The limitations imposed by these detection errors in the t-pattern analysis of the limited dataset used in the current study are duly acknowledged. Hence the t-patterns selected for further analysis are by no means exhaustive in exemplifying the various types of verbal mediation of behaviour that might have occurred in the naturalistic data recorded in the current study. However a few of those t-patterns were selected from each of the four speech and goal-sharing conditions, to provide illustrative examples of the three types of contextual functions derived from previous analyses (refer to **Section 6.7.2**), as well as highlight the presence of both *verbal control* as well as *verbal commentary*, as the types of verbal mediation of behaviour employed by the children in this study. Hence for each of the contextual functions of speech, namely, *goal-directed regulation of behaviour*, *communication for managing situations*, and *communication for informing others*, a t-pattern containing one or more of the highlighted speech-behaviour pairs from **Table 6.8** was selected for each of the speech-goal conditions which exhibited that particular function. A specific instance of the occurrence of that t-pattern in the recorded dataset from the classroom was then analysed in detail, laying out the 'description of the context', 'transcript of events' and finally the 'analysis of events'.

6.8.1 Goal-directed regulation of behaviour

The contextual function of *goal-directed regulation of behaviour (self* and *other)* highlighted in orange in **Table 6.8** and later in **Table 6.9** comprised correlated and co-occurring speech-behaviour pairs in the **ps_I_goal, ps_we_goal** and **soc_we_goal** conditions. T-patterns obtained under each of the three conditions are contextually analysed in the sections below, confirming the real-time verbal mediation of behaviour actualised through the function of *goal-directed regulation of behaviour*.

6.8.1.1 Ps_I_goal
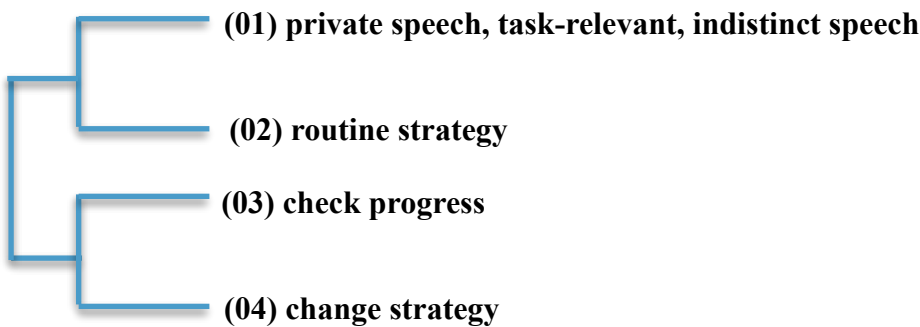
Figure 6.3 T-pattern extracted from ps_I_goal condition: no. of occurrences = 11; pattern length = 4; pattern level = 2

The t-pattern illustrated in **Fig. 6.3** was obtained within the ps_I_goal condition, with the speech category *indistinct speech* both co-occurring and correlated with goal-directed behaviours *routine strategy, change strategy* and *check progress* (Refer to **Table 6.8**, second column under ps_I_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.12** below.

Table 6.12 Correlating and co-occurring behavioural pairs in the ps_I_goal condition for behavioural categories representing the contextual function - '**goal-directed regulation**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

ps_I_goal		
Contextual function	**Goal-related behaviour**	**Pragmatic speech category**
Goal-directed regulation of behaviour (self & other)	<u>Change strategy</u>	<u>indistinct</u>
	<u>Routine strategy</u>	<u>indistinct</u>
	Search strategy	
	<u>Check progress</u>	<u>indistinct</u>
	Notice issue/error	

The pattern occurred 11 times in the ps_I_goal dataset, with three internal intervals spanning across the four events in the patterns. Pattern statistics describing the three internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = .38s; **Max I1** (longest time interval between events 1 and 2 in all pattern occurrences) = 11.90s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = .79s; **Max I2** (longest time

interval between events 2 and 3 in all pattern occurrences) = 63.84s; **Min I3** (shortest time interval between events 3 and 4 in all pattern occurrences) = .87s; **Max I3** (longest time interval between events 3 and 4 in all pattern occurrences) = 38.71s.

One instance of its occurrence during a goal-directed episode involving Child 8 is described below. The general context of the occurrence is described first, followed by a timed and coded transcript of the events, not all of which were picked up in the t-pattern search. The events in the transcript which are part of the t-pattern are illustrated in bold. An analysis of the events is then carried out to understand the probable functional relationship between the speech and behaviours that occur in the t-pattern in the given context.

Child 8, I_goal: building a 'bridge' next to the tower

Description of the context:

The above t-pattern was extracted from a constructional play context where Child 8 was playing with another child as they were engaged in stacking wooden blocks to build various structures. At this point, the two children had already built a tower with the blocks, and the other child was now engaged in placing some animal play-figures on top of the built structure. Child 8 was pursuing his personal goal of building a 'bridge' next to the tower, which he had declared in an earlier part of the episode. He searched for more blocks from the pile of blocks placed behind him. He found and picked two new blocks, one small and square shaped and the other long and rectangular shaped, and then turned towards the structure to place them on top of the 'bridge' that he was building. The transcript of events given below begins with Child 8's next action. He placed the square block next to an identical square block already placed on the structure, produced an utterance of private speech, and then placed the second rectangular block on top of the two square blocks. **Fig. 6.4** below is a snapshot of this moment when Child 8 was placing the long block on top of the 'bridge'.

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Figure 6.4 Snapshot of the moment when a *routine strategy* is applied by Child 8 to attain his goal of building a 'bridge', by placing a long rectangular block on the 'bridge' structure.

Transcript of events:

(1) 731.82s : [Child 8] Places the square block in his hand adjacent to the previously placed square block **<routine strategy>**

(2) **732.61s : [Child 8] "*It's been holding the [...] from the ceiling*" <private speech, task-relevant, indistinct speech : unclear_unrecordable>**

(3) **733.08s : [Child 8] Places the long rectangular block on top of the two small square blocks, in an orthogonal orientation <routine strategy>**

(4) **734.55s : [Child 8] Examine the suitability of the position and the stability of the long block <check progress>**

(5) **735.52s : [Child 8] Change the position of the long block and place it adjacent to the square blocks <change strategy>**

(6) 737.56s : [Child 8] The long block is not stable, falls down**<failed strategy>**

Analysis of events:

In line (2) of the transcript, Child 8 uttered a private speech categorised as task-relevant *indistinct speech,* which was of a lowered volume with some words only identified as lip movements, compared to other utterances in the episode (not mentioned here) which were louder and were clearly addressed to the other child. The content of the speech also referred to objects which only had a private meaning for the child ("It's been holding…"), which he did not explain or elaborate in any other utterance preceding or following it. Due to this unclear private meaning of the utterance as well as some portions of the speech spoken with a very low volume and identified as lip movements, it was coded as *unclear_unrecordable* speech and categorised under *indistinct speech.* Such speech is usually categorised as *external manifestations of inner speech*, and is considered to

be the most mature form of private speech in the commonly used three-level coding system in the private speech literature, due to its abbreviated and semi-internalised form (Berk, 1986; Winsler, 1998; Winsler et al, 2003, Fernyhough & Fradley, 2005). Despite the ambiguity of its content, this utterance was still classified as task-relevant, since it referred to real or imaginary parts of the structure which Child 8 was building, such as "holding the […] from the ceiling". The unclear utterance given in square parentheses, which was only visible as lip movements, seems to refer to another part of the 'bridge', structurally related to the 'ceiling' according to Child 8. Since a part such as a 'ceiling' was not clearly identifiable in the structure being built by the child, it may have been an imaginary part of the 'bridge', with the blocks that he was placing on to the structure being transformed through his speech to stand for these imaginary structural parts. It is common for children to refer to such imaginary parts or structures while involved in constructional play, in order to transform the structure or model that they are building to a real-life structure that they intend to copy and build during their play. Such utterances have been referred to as *object transformations* in the pretend play literature (D'Orazio, 1994). These utterances do not merely function as a commentary of the actions being undertaken, since they add relevance and meaning to the actions rather than simply describe them. Since the goal of this activity for Child 8 was not merely building a structure with the wooden blocks, but building a 'bridge' next to the 'tower' that they had already built, such an utterance verbally aided in achieving the goal from the perspective of the child. This utterance was followed by a goal-oriented *routine strategy* of placing the block on top of the structure, thus furthering the attainment of the personal goal of building the 'bridge'. Hence the private speech in line (2) appeared to be a description of the plan, albeit meant for himself, according to which Child 8 was verbally guided to carry out the actions to attain his goal. Moreover the utterance also seemed to verbally highlight and emphasise the object involved in the action, namely the rectangular block in this case, thereby holding it in the visual attention of the child. Hence when child 8 placed the rectangular block on top of the structure, he continued to monitor its stability (categorised in line (4) as *check progress*), and then decided to change its position (categorised in line (5) as *change strategy*), after having judged that the block was unstable in its current position. Upon examining the temporal order of speech and behaviours in this t-pattern, it was clear that *indistinct speech* was followed by both *routine strategy* as well as *check progress,* thus indicating verbal mediation of behaviour in the form of *verbal control,* particularly verbal emphasis of goal-relevant information. Hence private speech was employed for regulatory purposes, acting upon the *self* as a direct *process.* This matches with the predictions made according to the Contextual Model of Verbal Mediation in **Section 6.6.1.1** for private speech in the I_goal

context, which had suggested the presence of **Type A** speech profile (private_preceding_self_process) in such a context.

6.8.1.2 Ps_we_goal

(01) notice error/issue

(02) private speech, task-relevant, informative

(03) change strategy
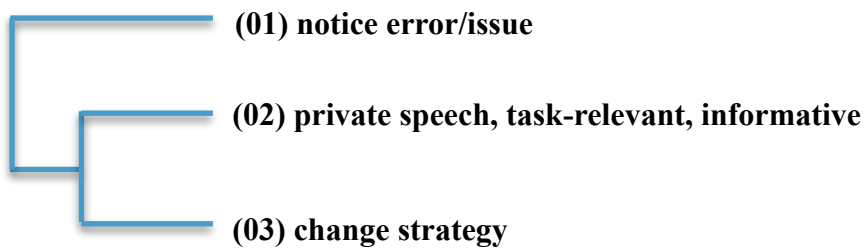
Figure 6.5 T-pattern extracted from ps_we_goal condition: no. of occurrences = 14; pattern length = 3; pattern level = 2

The t-pattern illustrated in **Fig. 6.5** was obtained within the ps_we_goal condition, with the speech category *informative* both co-occurring and correlated with goal-directed behaviours *notice error/ issue* and *change strategy* (Refer to **Table 6.8**, third column under ps_we_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.13** below.

Table 6.13 Correlating and co-occurring behavioural pairs in the **ps_we_goal** condition for behavioural categories representing the contextual function - '**goal-directed regulation**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

<div align="center">

ps_we_goal

</div>

Contextual function	Goal-related behaviours	Pragmatic speech category
Goal-directed regulation of behaviour (self & other)	<u>Change strategy</u>	<u>informative</u>, indistinct
	Routine strategy	informative, other
	Search strategy	
	Check progress	
	<u>Notice error</u>	<u>informative</u>, other

The pattern occurred 14 times in the ps_we_goal dataset, with two internal intervals spanning across the three events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** = .10s; **Max I1** = 20.56s; **Min I2** = .04s; **Max I2** = 6.00s. One instance of its occurrence during a goal-directed episode involving Child 3 is described below.

Child 3, we_goal: playing 'at the vets'

Description of the context:

The above t-pattern was extracted from a pretend play context where Child 3 was playing with two other children. Child 3 was playing the role of a veterinary surgeon along with another child, while the third child pretended to be the owner of a 'sick dog', a stuffed toy dog, who was visiting the animal clinic. The shared goal of the activity was to extend the script of 'being at the vets' where each child was extending the script with their respective role-plays. There was a table in the middle in the play area which had several props placed on it, such as some plastic toy bones, a dog bowl, a torch, two stuffed toy animals, etc. A toy pet carrier was placed on a chair on one side of the play area. At this point in the activity, Child 3 had picked up the 'sick dog' from the table and wanted to give a 'bone' which she had found on the table, to the 'dog'. She wanted to give the bone to the dog in the pet carrier, but was unable to open the lid of the carrier. The transcript of events given below begins with this event of *failed strategy* by Child 3. Hence she changed her mind and then addressed the 'owner' in the role of a 'vet' and announced that she would give this bone to her dog elsewhere. She then turned back towards the table to find a new place to give the bone, when she noticed more plastic toy bones on the table. She then produced a private speech utterance in a lowered volume, without making eye contact with anyone else, in which she referred to the other bones that she had noticed on the table as *"all of the bones.* After this she changed her ongoing strategy of giving just one bone to the dog, and instead picked up all the bones with the intention of feeding them to the dog. **Fig. 6.6** is a snapshot of this moment when Child 3 was picking up the other bones placed on the table. The events from this episode which are present in the t-pattern are highlighted in bold in the transcript of events given below.

Figure 6.6 Snapshot of the moment when Child 3 applied a *change strategy* of picking up all the bones on the table to give to the 'dog' instead of just one bone, after noticing them on the table.

Transcript of events:

(1) 103.80s: [Child 3] Unable to open the lid of the toy pet carrier placed on the chair **<failed strategy>**

(2) 104.40s: [Child 3] *"Oh, we'll give this, your dog.."* **<social speech, task-relevant, informative: pretence_ulterior conversation>**

(3) 105.04s: [Child 3] Move away from the pet carrier and turn towards the table to give the 'bone' to the 'dog' elsewhere **<change strategy>**

(4) 105.68s: [Child 3] Notice the other 'bones' on the table <notice error/issue>

(5) 106.28s: [Child 3] *"The…all of the bones"* <private speech, task-relevant, informative: pretence_ulterior conversation >

(6) 106.64s: [Child 3] Move towards the table to pick up and all of the bones instead of just the one in her hand <change strategy>

Analysis of events:

In line (2) of the transcript, Child 3 uttered a social speech, where she referred to the bone in her hand which she was about to give to the dog as *"we'll give this"*. The speech was classified as social because Child 3 started speaking while facing the other child who was role-playing as the 'owner' of the 'dog'. The content of the utterance included the words *"your dog"*, where the possessive pronoun *"your"* also seemed to refer to the 'dog's owner'. The speech was labeled as

task-relevant, since it referred to objects and children involved in the pretend play with the aim of extending the role-play script. The utterance was produced by Child 3 within the pretend framework, while enacting the role of a 'vet', but it also indirectly introduced a new element to the script, and informed others about the introduction of this new element. Hence the utterance was coded as *pretence_ulterior conversation*. (Refer to **Table 4.3** in **Chapter 4** and **Appendix D** for a detailed definition of these speech categories). For the purpose of the t-pattern search, this was categorised under the pragmatic category of *informative speech*. The speech utterance in line (5) was also similarly categorised as *task-relevant, pretence_ulterior conversation* and *informative speech* for the same reasons mentioned above. However, it was classified as private speech, since it was produced with a much lowered volume compared to the social speech in line (2), and did not involve any behavioural and linguistic indicators of being addressed to others, as was the case with the previous utterance. Child 3 had her back turned towards the other children while producing this utterance. In line (4), noticing the other bones on the table was coded as *notice error/issue* since it was relevant to the shared goal being pursued by Child 3. She subsequently added this additional element to the script, thereby furthering the attainment of the goal. By producing the private speech utterance in line (5), Child 3 seemed to verbally inform herself about the new element of the 'other bones on the table' that she had just noticed as well as guide her towards changing her previous strategy to the new one, which included the new elements in the role-play script, as mentioned in line (6). Hence, in this t-pattern, the temporal order of the *informative speech* situated between the two goal-directed behaviours indicated both *verbal commentary* for the mediatory relationship between *notice error/issue* followed by *informative speech* and *verbal control* for the mediatory relationship between *informative speech* followed by *change strategy*. While the first mediatory relationship of *verbal commentary* through private speech could be represented by the **Type B** speech profile (private_following_self_process), the second mediatory relationship of *verbal control* through private speech could be represented by the **Type A** speech profile (private_preceding_self_process). Moreover, since all the children were involved in a shared goal of playing 'at the vets', the private speech utterance could have also performed a communicative function of indirectly informing others about the actions of Child 3. This could be an example of private speech acting as a *product* for others, and hence represented by the **Type F** speech profile (private_following_other_product). All of the above speech profiles have been predicted by the Contextual Model in **Section 6.7.1.2**

6.8.1.3 Soc_we_goal

(01) social speech, task-relevant, evaluative

(02) change strategy
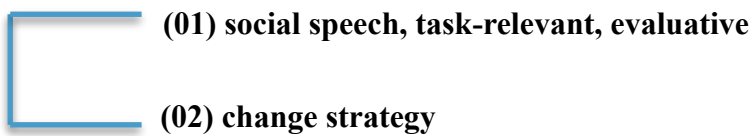
Figure 6.7 T-pattern extracted from soc_we_goal condition: no. of occurrences = 13; pattern length = 2; pattern level = 1

The t-pattern illustrated in **Fig 6.7** was obtained within the soc_we_goal condition, with the speech category *evaluative* both co-occurring and correlated with goal-directed behaviour *change strategy* (Refer to **Table 6.4**, last column under soc_we_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.14** below.

Table 6.14 Correlating and co-occurring behavioural pairs in the **soc_we_goal** condition for behavioural categories representing the contextual function - '**goal-directed regulation**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

soc_we_goal

Contextual function	Goal-related behaviours	Pragmatic speech category
Goal-directed regulation (self & other)	<u>**Change strategy**</u>	directive, informative, <u>**evaluative**</u>, agree/disagree, indistinct
	Routine strategy	directive, informative, evaluative, agree/disagree, indistinct
	Search strategy	informative, indistinct
	Check progress	directive
	Notice error	directive, informative

The pattern occurred 13 times within the soc_we_goal dataset, with one internal interval spanning across the two events in the pattern. Pattern statistics describing the internal interval are as follows: **Min I1** = .38s; **Max I1** = 15.24s. An instance of its occurrence during a goal-directed episode involving Child 4 is described below.

Child 4, we_goal: 'tidying up' the playhouse

Description of the context:

The above t-pattern was extracted from a 'tidying up' session at the end of the playtime in the classroom, when children were expected to rearrange the play-area where they had been playing last. Child 4 was jointly involved in arranging the contents of a wooden playhouse with another child. The second child had just placed a wooden 'staircase' at one side of the playhouse. Child 4 then came towards him. The transcript of events begins from the point in the activity when Child 4 noticed the inappropriate position of the 'staircase', placed there by the other child. After noticing the error, she produced an *evaluative* social speech utterance regarding the staircase, stating that the staircase did not belong to the position where the other child had just kept it. She then picked up the 'staircase' and later continued to place it on another side of the playhouse. **Fig. 6.8** below is a snapshot of this moment when Child 4 picked up the staircase from one side of the playhouse. Then the other child uttered a social speech, agreeing with Child 4 about the inappropriate position of the staircase. The two events present in the t-pattern are highlighted in bold in the transcript of events given below.

Figure 6.8 Snapshot of the moment when Child 4 (girl in pink dress) applied a *change strategy* by picking up the 'staircase' placed erroneously by the other child at the side of the playhouse.

Transcript of events:

(1) 197.16s: [Child 4] Notice the inappropriate position of the wooden staircase placed on one side of the playhouse **<notice error/issue>**

(2) **197.26s: [Child 4]** *"That don't go here"* **<social speech, task-relevant, evaluative: evaluating task >**

(3) **197.86s: [Child 4] Remove the staircase from where the other child had placed it <change strategy>**

(4) 199.26s: [other child] *"No! Fa-dah-tah!"* **<social speech, task-relevant, agree/disagree: agreement with previous speaker >**

Analysis of events:

After noticing the error made by the other child in placing the staircase in line (1) of the transcript, Child 4 uttered a social speech in line (2). The speech was classified as social because Child 4 had been referring to the other child by his name in her previous utterance, and hence this utterance seemed to continue with addressing the other child, although without making direct eye-contact with him. The speech was labeled as task-relevant, since it referred to an object (i.e., the staircase) which was directly involved in the attainment of the shared goal of tidying up the playhouse. The utterance evaluated the accuracy of a component of the tidying-up task (*"That don't go here"*). Hence it was coded as *evaluating task,* and placed under the pragmatic category of *evaluative speech.* The utterance verbally emphasised the error made by the other child, both for herself as well as the other child present there. Child 4 then proceeded to correct the error highlighted in the previous speech utterance by removing the staircase from its inappropriate position, thereby changing the previous strategy used by the other child in placing the staircase. This was categorized as *change strategy* in line (3). The social speech utterance produced by the other child in line (4) announced his agreement with the evaluation and subsequent change made by Child 4 in rearranging the position of the staircase. Hence the above analysis of the context and temporal order of the *evaluative* speech followed by the goal-directed behaviour of *change strategy* indicated *verbal control* and particularly in the form of verbal emphasis as the mediatory relationship between the social speech and behaviour pair, both for the *self* (indirectly as a *product)* as well as for the *other* (directly as a *process)*. Hence these mediatory relationships could be represented by the **Type G** (social_preceding_self_product) and **Type C** (social_preceding_other_process) speech profiles respectively. Both these speech profiles have been predicted by the Contextual Model for social speech in the shared goal context in **Section 6.7.1.2.**

6.8.2 Communication for managing situations

The contextual function of *communication for managing situations* highlighted in purple in **Table 6.8** and later in **Table 6.10** comprised correlated and co-occurring speech-behaviour pairs in the **soc_I_goal,** and **soc_we_goal** conditions. In both the I_goal and the we_goal conditions, the social speech utterances in these pairs, fulfilled a communicative function for managing situations, either when others intervened in the on-going activity (e.g., *regulated by other)* of the focal child or when the focal child needed to intervene in the activity of others to attain her goal (e.g., *regulate others*). T-patterns obtained under the two conditions are contextually analysed in the sections below, confirming the real-time verbal mediation of others' behaviour actualized through the function of *communication for managing situations.*

6.8.2.1 Soc_I_goal

(01) regulated by other

(02) social speech, task-relevant, informative

Figure 6.9 T-pattern extracted from soc_I_goal condition: no. of occurrences = 14; pattern length = 2; pattern level = 1

The t-pattern illustrated in **Fig. 6.9** was obtained within the soc_I_goal condition, with the goal-relevant event *regulated by other* both correlated and co-occurring with the pragmatic category of *informative* speech (Refer to **Table 6.8**, fourth column under soc_I_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.15** below.

Table 6.15 Correlating and co-occurring behavioural pairs in the **soc_I_goal** condition for behavioural categories representing the contextual function - '**communication for managing situations**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

soc_I_goal

Contextual functions	Goal-related behaviours	Pragmatic speech category
Communication for managing situations	**Regulate others**	directive, informative
	Facilitated by other	directive, indistinct
	Regulated by other	directive, **informative**

The pattern occurred 14 times in the soc_I_goal dataset, with one internal interval spanning across the two events in the pattern. Pattern statistics describing the internal interval are as follows: **Min I1 = .06s; Max I1** = 18.44s. An instance of its occurrence during a goal-directed episode involving Child 5 is described below.

Child 5, I_goal: enter the ongoing game of 'at the hairdressers' by using a prop

Description of the context:

The above t-pattern was extracted from a pretend play session where two other children apart from Child 5 were already enacting the script of 'at the hairdressers'. One of the children was seated on a chair and was playing the role of the 'customer' while the other child was the 'hairdresser'. Child 5 wanted to join their game as another 'hairdresser' and hence inclusion into the game was his personal goal at this point in the activity. He tried to enter the on-going game by pretending to use a prop (a toy hair straightener) on the hair of the 'customer', with the hope that the prop would be accepted and incorporated by the other two children into the ongoing role-play script. The transcript begins with this routine strategy used by Child 5. When the 'customer' moved his head away from the straightener, Child 5, acting as a 'hairdresser', sought permission from the 'customer' to use this gadget on his hair. The child playing the role of the customer then tried to remove the hair straightener away from his head and hence refused to incorporate the new prop into their game. **Fig. 6.10** is a snapshot of the moment when the child acting as the customer prevented Child 5 from using the hair straightener as a prop. Child 5 however continued in his role-play and asked the 'customer' - "*Is that a bit hot?*".

Figure 6.10 Snapshot of the moment when Child 5 (the standing boy) is **regulated by other,** as he is stopped by the other child from using the prop in his hands.

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Transcript of events:

(1) 46.92s: [Child 5] Use the hair-straightener as a prop on the 'customer's' hair **\<routine strategy\>**

(2) 47.80s: [Child 5] *"Can I do this?"* **\<social speech, task-relevant, informative: pretence_ulterior conversation\>**

(3) 49.20s: [Child 5] Child 5 is stopped by the other child from using the hair straightener \<regulated by other\>

(4) 50.84s: [Child 5] *"Is that a bit hot?"* \<social speech, task-relevant, informative: pretence_ulterior conversation\>

Analysis of events:

Both the speech utterances produced by Child 5 in the above transcript (in line (2) and line (4)), were social in nature as they addressed the other child directly while making eye-contact. The utterances were also task-relevant, since they referred to actions and objects involved in the pretend play with the aim of extending the role-play script. Both the utterances were produced by Child 5 within the pretend framework, while playing the role of a 'hairdresser', but they also indirectly introduced new elements to the script, and informed others about the introduction of these new elements. Hence the utterances were coded as *pretence_ulterior conversation* and were categorised under the pragmatic category of *informative speech.* The utterance in line (2) introduced the new element into the script of a 'hairdresser' asking permission from the 'customer' to use a new gadget on his hair, while the utterance in line (4) introduced the element of the 'hairdresser' asking and confirming the reason for refusal to try the new gadget from the 'customer'. In line (3), even after being prevented from using the hair straightener and hence being regulated by the other child from attaining his personal goal of getting included in the game, Child 5 did not give up his goal pursuit. Instead of accepting this refusal as a failure to attain his goal, he tried to manage the situation by incorporating the refusal into the script itself and hence continue to remain in the game. Hence, in this t-pattern, the temporal order and context of the goal-relevant event *regulated by other* followed by *informative speech* indicated using social speech for others in a communicative manner by managing the situation to avoid failure. This could be represented by the **Type D** speech profile (social_following_other_process), which was predicted by the Contextual Model in **Section 6.7.1.1.**

6.8.2.2 Soc_we_goal

(01) social speech, task-relevant, directive

(02) regulate others

The t-pattern illustrated in **Fig. 6.11** was obtained within the soc_we_goal condition, with the pragmatic category of *directive speech* both correlated and co-occurring with the goal-directed behaviour *regulate others* (Refer to **Table 6.8**, last column under soc_we_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.16** below.

Table 6.16 Correlating and co-occurring behavioural pairs in the **soc_we_goal** condition for behavioural categories representing the contextual function - '**communication for managing situations**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

soc_we_goal

Contextual functions	Goal-related behaviours	Pragmatic speech category
Communication for managing situations	<u>**Regulate others**</u>	<u>**directive**</u>, informative
	Facilitated by other	
	Regulated by other	directive, informative

The pattern occurred 16 times in the soc_we_goal dataset, with one internal interval spanning across the two events in the pattern. Pattern statistics describing the internal interval are as follows: **Min I1** = .10s; **Max I1** = 19.84s. An instance of its occurrence during a goal-directed episode involving Child 7 is described below.

Child 7, we_goal: building a 'dinosaur shelter' from Duplo® bricks

Description of the context:

The above t-pattern was extracted from a constructional play episode wherein Child 7 was jointly building a 'dinosaur shelter' from Duplo® bricks with another child. Both the children were involved in building a closed structure with the bricks to place some of their toy 'dinosaurs' inside it. Child 7 had previously fixed a brick with one of its edges having a concave curved shape instead of a regular straight shape. Due to the curved edge, it did not fit well with the other bricks and had been removed by Child 7 earlier and put aside, as it impeded their joint goal of building a closed and stable structure. Now the other child picked up the same curved brick and fixed it on one of the walls of the structure. The transcript of events begins with Child 7 noticing the erroneous action being conducted by the other child. He then instructed the other child to not put that brick back on the structure, which he had removed from the structure some time ago. Then he physically removed the brick himself and proceeded to explain why the removal of that brick was crucial for attaining their goal. **Fig. 6.12** is a snapshot of the moment when Child 7 stopped the other child from fixing the curved brick on the structure and continued to remove it.

Figure 6.12 Snapshot of the moment when Child 7 (boy in red trousers) **regulates other,** as he stops the other child from placing an inappropriate Duplo® brick on the structure.

Transcript of events:

(1) 387.63s: [Child 7] Notice the other child placing the curved red piece on the structure **<notice error/issue>**

(2) 388.31s: [Child 7] *"No don't put that back"* <social speech, task-relevant, directive: directing/stating a rule>

(3) 388.51s: [Child 7] Prevent the other child from adding the curved red piece to the structure again <regulate others>

(4) 390.02s: [Child 7] "Then it all gonna stay [..]" **<social speech, task-relevant, evaluative: consequential/if-then statement>**

Analysis of events:

The speech utterance produced by Child 7 in line (2) was social in nature and was coded as *directing/ stating a rule* as it clearly instructed the other child to not do something. The utterance was categorised under the pragmatic category of *directive speech* and was also task-relevant as it was directed towards correcting an error made by the other child, which according to Child 7 would have impeded their goal attainment. In line (3), Child 7 continued to regulate the other child's actions by directly removing the curved block. After removing the curved block, he explained in line (4) with a *consequential/ if-then statement* that this would help all the other blocks to stay together, perhaps by fixing properly to each other. The other child did not object to this intervention carried out by Child 7 and the joint constructional activity continued without being interrupted by this situation. However, if Child 7 had directly removed the inappropriate brick without giving any forewarning with his directive speech, the regulatory action by Child 7 might have come across as more abrupt and aggressive to the other child. Hence the *directive speech* was successful in verbally managing a confrontational situation wherein Child 7 wanted to regulate the other child's behaviour by correcting his erroneous action. Hence social speech was used directly for the other and fulfilled a communicative purpose. This could be represented by the **Type C** speech profile (social_preceding_other_process), as was predicted by the Contextual Model in **Section 6.7.1.2**

6.8.3 Communication for informing others

The contextual function of *communication for informing others* highlighted in yellow in **Table 6.8** and later in **Table 6.11** comprised correlated and co-occurring speech-behaviour pairs in the **soc_I_goal,** and **soc_we_goal** conditions. In both the goal conditions, the social speech utterances in these pairs, seemed to fulfil a communicative function for informing others about the initiation, termination or progress of the goal-directed activity. The communication could be meant for notifying others about one's future course of action (for e.g., with *new goal pursuit* and *return to previous goal)*, explaining or excusing one's failure (for e.g., with *failure to attain goal* and *leave goal pursuit),* making a request for help (for e.g., with *failed strategy*) or informing others about one's achievement (for e.g., with *goal attained*) and the state of progress of the ongoing activity (for e.g., with *disruption*). T-patterns obtained under each of the two conditions are contextually analysed in the sections below, confirming the real-time verbal mediation of others' behaviour actualised through the function of *communication for informing others.*

6.8.3.1 Soc_I_goal

(01) social speech, task-relevant, directive
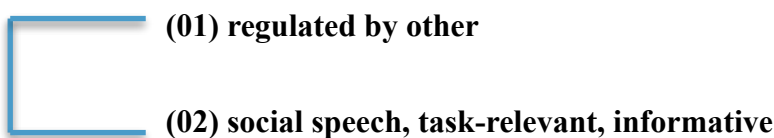
(02) leave goal pursuit
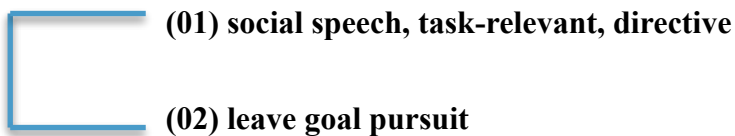
Figure 6.13 T-pattern extracted from soc_I_goal condition: no. of occurrences = 14; pattern length = 2; pattern level = 1

The t-pattern illustrated in **Fig. 6.13** was obtained within the soc_I_goal condition, with the pragmatic category of *directive* speech both correlated and co-occurring with goal-relevant behaviour *leave goal pursuit* (Refer to **Table 6.8**, fourth column under soc_I_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.17** below.

soc_I_goal

Contextual functions	Goal-related behaviours	Pragmatic speech category
Communication for informing others	**Disruption**	
	Failed strategy	directive, informative
	Goal attained	directive, informative, agree/disagree
	New goal pursuit	informative
	Return to previous goal	
	<u>Leave goal pursuit</u>	<u>**directive**</u>
	Start focused activity	directive

The pattern occurred 14 times in the soc_I_goal dataset, with one internal interval spanning across the two events in the pattern. Pattern statistics describing the internal interval are as follows: **Min I1 = 1.3s; Max I1 = 29.20s.** An instance of its occurrence during a goal-directed episode involving Child 6 is described below.

Child 6, I_goal: untangling a hair tie from the 'customer's' hair while playing 'hairdresser'

Description of the context:

The above t-pattern was extracted from a pretend play session where Child 6 and two other children were enacting the script of 'at the hairdressers'. Child 6 along with another child was the hairdresser, while the third child was seated in front of a toy dressing table and was playing the role of the customer. All three children had been involved in a joint role-play of 'at the hairdressers'. In order to play her part of the 'hairdresser', Child 6 had been using several props with the 'customer', the last of which was a hair-tie with which she was trying to tie the 'customer's' hair. However the hair-tie had got entangled in the 'customer's' hair. Hence Child 6 was now involved in a personal goal of taking out the entangled hair tie from the other child's hair. The transcript of events begins with a failed attempt made by Child 6 in untangling the hair-tie from the other child's hair. She was then distracted from her task as she looked at some of her other classmates playing nearby. Her strategy to take out the hair-tie failed, upon which she used the same strategy again. After this she

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tried to look for another prop, while still fiddling with the customer's hair. She then addressed the other children around her and said - *"Its nearly five, who's the hairdresser now?"*. After this, she left her goal pursuit of trying to take out the stuck hair-tie and started looking for other props to play. **Fig. 6.14** is a snapshot of the moment when Child 6 asked the others about the next hairdresser, while still holding the hair-tie stuck in the other child's hair.

Figure 6.14 Snapshot of the moment when Child 6 (the standing girl holding the other child's hair) produces a ***directive*** social utterance, as she continues to hold the hair-tie stuck in the other child's hair .

Transcript of events:

(1) 208.00s: [Child 6] Try to untangle the hair-tie by sliding it through the hair again **<repeat failed strategy>**

(2) 209.16s: [Child 6] Look at children playing nearby **<external distraction>**

(3) 212.24s: [Child 6] Hair-tie gets stuck in the hair further **<failed strategy>**

(4) 213.36s: [Child 6] Look for another prop on the 'dressing table' **<search strategy>**

(5) **215.22s: [Child 6]** *"Its nearly five, who's the hairdresser now?"* **" <social speech, task-relevant, directive: pretence_implicit pretend structuring>**

(6) **216.48s: [Child 6] Leave attempting to take out the hair-tie from the 'customer's' hair <leave goal pursuit>**

(7) 217.06s: [Child 6] Find other props to play with **<new goal pursuit>**

Analysis of events:

The series of events leading up to the social speech utterance in line (5) clearly show that Child 6 had been trying the same strategy (*repeat failed strategy* in line (1)) and then facing repeated failures (*failed strategy* in line (3)) in her goal to untangle and remove the hair-tie from the other child's hair. Behaviours such as getting distracted and looking around at other children (*external distraction* in line (2)) and searching for other props (*search strategy* in line (4)) indicate attempts to ignore the current situation and look for ways to get out of the current situation, respectively. Hence faced with repeated failures, Child 6 finally stopped further attempts to pursue her goal (*leave goal pursuit* in line (6)) and moved on to another goal (*new goal pursuit* in line (7)). The speech utterance in line (5) produced by the child just before leaving her goal was social in nature, as it was addressed to the other two children playing with her. It was also relevant to the goal, since it referred to the on-going role-play script of 'at the hairdressers', and tried to extend it by suggesting that somebody else should play the role of the hairdresser. The initial part of the utterance – *"It's nearly five…"* confirmed that Child 6 was still speaking from within the pretend framework, and referring to the time in the script. The second part of the utterance – *"…who's the hairdresser now?"*, tried to change the structure of the game by enquiring about the next person who would play the role of the hairdresser. The suggestions in the utterance were made implicitly, without making overt references to the pretend framework. Hence it was coded as *pretence_implicit pretend structuring* and placed under the pragmatic category of *directive speech* since it indirectly instructed others to follow the changes being suggested by her. The utterance produced by the child just before leaving the on-going goal pursuit seemed to announce to the other players, her desire to leave the role of the hairdresser and ask someone else to play the role instead. The decision to leave the role was also phrased as being part of the script itself, by referring to the time and suggesting that it was too late, and hence a change of duties was needed as a result. This also served to conceal her own failure to attain her goal by not being able to remove the hair-tie from the other child's hair. Hence the *directive speech* was successful in verbally informing others about one's future course of action, while also excusing one's own past failure, whether done intentionally or unintentionally. This could be represented by the **Type C** speech profile (social_preceding_other_process), as predicted by the Contextual Model in **Section 6.7.1.1.**

6.8.3.2 Soc_we_goal

(01) new goal pursuit

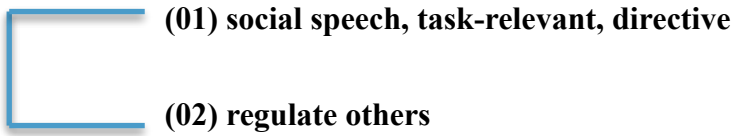**(02) social speech, task-relevant, directive**
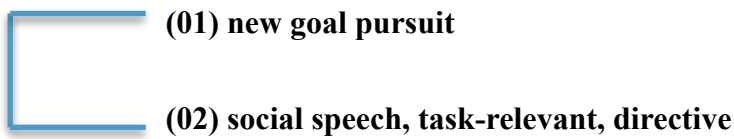
Figure 6.15 T-pattern extracted from soc_we_goal condition: no. of occurrences = 47; pattern length = 2; pattern level = 1

The t-pattern illustrated in **Fig. 6.15** was obtained within the soc_we_goal condition, with goal-relevant behaviour *new goal pursuit* both correlated and co-occurring with the pragmatic category of *directive* speech (Refer to **Table 6.8**, last column under soc_we_goal). For ease of reference, this section of **Table 6.8** is reproduced in **Table 6.18** below.

Table 6.18 Correlating and co-occurring behavioural pairs in the **soc_we_goal** condition for behavioural categories representing the contextual function - '**communication for informing others**' (extracted from Table 6.8). The behaviour and speech events appearing in the selected t-pattern are underlined.

soc_we_goal

Contextual functions	Goal-related behaviours	Pragmatic speech category
Communication for informing others	Disruption	evaluative, indistinct
	Failed strategy	directive, indistinct
	Goal attained	directive, informative
	New goal pursuit	directive, informative
	Return to previous goal	informative
	Leave goal pursuit	
	Start focused activity	

The pattern occurred 47 times in the soc_we_goal dataset, with one internal interval spanning across the two events in the pattern. Pattern statistics describing the internal interval are as follows: **Min I1** = 0.01s; **Max I1** = 33.11s. An instance of its occurrence during a goal-directed episode involving Child 1 is described below.

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Child 1, we_goal: making dinner

Description of the context:

The above t-pattern was extracted from a pretend play session where Child 1 and another child were jointly enacting the script of 'making dinner' by adding and mixing assorted toys in a plastic bucket with a long plastic spoon (not mentioned in the transcript of events below). The two children had been enacting this script earlier, after which they stopped these actions after having decided between themselves that their goal had been achieved (i.e., dinner had been prepared) and instead started taking out the contents of the bucket and pretended to eat them. Since this activity of 'eating dinner' was not defined by a distant goal towards which the actions were aimed, but instead the actions in themselves were fulfilling the intentions of the children, it was categorised as *start a focused act* instead of being defined as a goal-directed episode. While the other child continued with this activity, Child 1 started to pursue a new goal, indicated by a change in her actions, wherein she stopped taking things out of the bucket and instead examined the remaining contents of the bucket and put back the spoon inside the bucket with the intention of mixing the contents with the spoon. Then she said to the other child – *"I'm just gonna mix"*, after which she carried out a routine strategy for enacting the script by mixing the contents of the bucket with the plastic spoon and pretending to make the 'dinner'. **Fig 6.16** is a snapshot of the moment when Child 1 started the new goal-directed activity by looking inside the bucket. The other child soon joined in the new goal pursuit and started adding the assorted toys to the bucket.

Figure 6.16 Snapshot of the moment when Child 1 (girl holding a spoon) initiates a **new goal pursuit** of 'making dinner' by looking inside the bucket

Transcript of events:

(1) 137.57s: [Child 1] Take out the contents of the bucket and 'eat' it **\<start a focused act\>**

(2) 163.05s: [Child 1] Examine the contents of the bucket, put the spoon inside the bucket \<new goal pursuit\>

(3) 163.06s: [Child 1] *"I'm gonna just mix"* \<social speech, task-relevant, directive: pretence_implicit pretend structuring \>

(4) 163.20s: [Child 1] Mix contents with spoon, pretend making dinner **\<routine strategy\>**

(5) 163.48s: [other child] Adds an object to the bucket

Analysis of events:

Child 1 had been engaged in a goal-directed episode earlier (not mentioned in the transcript) after which they started a focused activity (*start a focused act* in line (1)). After being engaged in this activity for a period of about 26 seconds, Child 1 stopped her previous actions and moved on to the goal-directed activity of 'making dinner' again (*new goal pursuit* in line (2)) identified by her change of focus and actions, intended to start pursuing the new goal. The other child was still engaged in the previous activity at this point of time. The speech utterance in line (3) produced by the child immediately after starting the new goal-directed activity was addressed to the other child and was relevant to the goal, since it referred to the actions that she was just about to perform, of mixing the contents of the bucket – *"I'm just gonna mix"*. The earlier script of 'making dinner' had involved the same action of mixing the contents of the bucket, and hence a reference to this action, indicated the beginning of the same script. Since the utterance did not refer to the pretend framework explicitly, but instead made an implicit proposal to resume the pretense of 'making dinner', it was coded as *pretence_implicit pretend structuring* and placed under the pragmatic category of *directive speech*. Soon after producing the utterance, Child 1 started mixing the contents of the bucket with her spoon (*routine strategy* in line (4)) and the other child took the cue and joined in the goal-directed activity (in line (5)) by putting back the contents of the bucket which they had taken out earlier. Hence the *directive speech* was successful in verbally informing the other child through direct social speech, about the change of activity and her future course of action. This could be represented by the **Type D** speech profile (social_following_other_process), as predicted by the Contextual Model in **Section 6.7.1.2.**

6.9 Summary of Results

Observations of the eight participants of the study, recorded in the classroom during goal-directed episodes, were analysed. Based on the conclusions reached in the previous chapter, the goal-directed episodes were divided into personal and shared goals, and examined separately. Correlations and temporal co-occurrences between goal-related behaviours and private and social speech utterances were calculated and compared within the dataset. Speech-behaviour pairs which were characterised by both, significant correlations and co-occurrences within a t-pattern, were considered to be temporally interacting in real time. Such temporal interactions were then contextually analyzed to investigate real time verbal mediations of behaviour. The following sections highlight the main findings for this chapter.

6.9.1 Correlation: insufficient condition for real-time verbal mediation

Private speech research primarily depends on correlational research as evidence of verbal mediation of behaviour. While claims regarding real-time mediation of behaviour are not explicitly made on the basis of correlations between speech utterances and relevant behaviours, any other possible mechanisms for the evidence obtained is usually not proposed either. The results obtained in this chapter clearly indicated that speech and behaviours that were found to be correlated did not always co-occur in real-time. Hence verbal mediation of behaviour in real-time could not be assumed from correlational data only and required further evidence through temporal co-occurrence within significantly recurring t-patterns. Speech-behaviour pairs which were correlated but did not co-occur could either be indicative of a mechanism operating on a longer timescale or a hidden factor mediating both speech and behaviour.

6.9.2 Correlation & co-occurrence: necessary condition for real-time verbal mediation

The findings suggested that task-relevant speech categories and goal-related behaviours which were significantly correlated (at p>.05) and also co-occurred within t-patterns, indicated temporal interaction in real-time. Hence *correlation with co-occurrence* was found to be a necessary (if not sufficient) condition for assuming real-time verbal mediation of behaviour. Further contextual analysis of the speech-behaviour pairs that fulfilled the condition of *correlation with co-occurrence*, revealed the actual goal-related behaviours that specific pragmatic categories of speech were mediating in real time. Hence *correlation with co-occurrence* coupled with contextual analysis of the speech-behaviour pairs fulfilling this condition was found to be the final and sufficient

condition for proving the presence of verbal mediation of behaviour within any temporal relation between speech and behaviour.

6.9.3 Validation of the Contextual Model of Verbal Mediation

The Contextual Model of Verbal Mediation was applied to the specific goal-sharing context of this study, wherein child-initiated goal-oriented episodes during preschool classroom activities were observed. The episodes were classified on the basis of the personal or shared nature of their goal into I_goal and we_goal episodes, respectively. The model when applied to this context, predicted three contextual functions of speech. Private speech in both the I_goal and the we_goal contexts was predicted to perform *goal-directed regulation of own behaviour* for regulating oneself directly, and *goal-directed regulation of others' behaviour* for regulating others indirectly in the we_goal context. Moreover, social speech in the we_goal context was also proposed to perform the function of *goal-directed regulation of others' behaviour,* albeit for directly regulating others towards the shared goal. Social speech produced in the I-goal context was predicted to be not required for performing goal-directed regulation for others, due to the personal nature of the goal. On the other hand, social speech in both the goal contexts was proposed to perform two communicative functions - *communication for managing situations* and *communication for informing others.*

The Contextual Model featured the *timing of speech* as a particular attribute of both social and private speech, wherein speech may be temporally related with relevant behaviour in two ways, namely*, preceding* or *following* the behaviour. The model proposed that the two types of speech based on its timing with behaviour, may indicate two types of real-time verbal mediation of behaviour, namely, *verbal control* and *verbal commentary.* Hence, the appearance of speech *preceding* relevant behaviour would indicate the function of *verbal control* upon the subsequent relevant behaviour, while the appearance of speech *following* relevant behaviour would indicate the function of *verbal commentary* based on the preceding relevant behaviour, which may in turn mediate subsequent behaviour. Hence, specific speech profiles were also predicted to appear in each of the goal contexts, based on the functions proposed by the model.

The results obtained in the study revealed that the correlated and co-occurring speech-behaviour pairs featuring within the four speech-goal conditions (ps_I_goal, ps_we_goal, soc_I_goal and soc_we_goal) featured in a similar pattern under each of the above-mentioned contextual functions of verbal mediation, as predicted by the model. Hence *goal-directed regulation of own behaviour*

was demonstrated by private speech co-occurring with goal-directed behaviours in the **ps_I_goal** and **ps_we_goal** and acting directly through the *process* of speaking. Moreover, *goal-directed regulation of others' behaviour* was also demonstrated indirectly as a *product* of speech by the same private speech utterance in the **ps_we_goal** condition, and directly as a *process* by social speech utterance in the **soc_we_goal** condition. Detailed temporal analysis confirmed that speech that was *preceding* the co-occurring behaviour in a t-pattern in the **ps_I_goal, ps_we_goal** and **soc_we_goal** conditions, did indicate verbal mediation of behaviour in the form of *verbal control,* through specific functions such as placing verbal emphasis on goal-relevant information prior to a goal-oriented control strategy (**ps_I_goal** and **soc_we_goal)** and verbally guiding one's behaviour (**ps_we_goal**). On the other hand, speech that was *following* the co-occurring behaviour in a t-pattern in the **ps_we_goal** condition indicated verbal mediation of behaviour in the form of *verbal commentary,* by reporting the contents of previous monitoring behaviour and in turn informing both herself and others about the just-noticed issue, before changing one's strategy as a result of the just-reported new information. Hence, the mutually interacting processes of *verbal control* and *verbal commentary* operating in tandem could be seen in this case, just like the cyclical processes of *control* and *monitoring* proposed by the Nelson and Narens' model (1990).

Communication for managing the situation was demonstrated by social speech co-occurring both after and before a potentially confrontational event, in the **soc_I_goal** and **soc_we_goal** condition respectively. Social speech utterances in the two conditions also demonstrated communication for informing others, both preceding and following a relevant behaviour. In the **soc_I_goal,** social speech preceding a relevant behaviour informed others about the future course of action, while in the **soc_we_goal,** social speech following a relevant behaviour informed the other child in the shared goal about the change of activity. The presence of those speech profiles which had been predicted by the model under each of these contextual functions (refer to **Fig 6.2**) were confirmed through the contextual analyses of the speech-behaviour pairs. Thus the results validated the predictions made by the model and presented an approach of revealing the functions of speech in the verbal mediation of behaviour by applying the model to a particular context

6.9.4 Context and not content of speech determines function

Another finding from these analyses revealed that the pragmatic content of speech did not have any exclusive relation with a particular contextual function of speech. Different types of pragmatic speech categories featured under one type of contextual function. And the same pragmatic speech

category appeared under different contextual functions. It was the context which determined how the pragmatic content of the speech might be involved in the verbal mediation of behaviour (self and others). Hence a one-to-one mapping between content and function is a simplistic way of understanding verbal mediation of behaviour, as shown by the contextual analyses conducted in this study. Therefore categorisations based on content (either semantic or pragmatic) should not be conflated with the functions of those speech categories.

Chapter 7. Results: Research Question 3

7.1 Introduction & Structure of Chapter

The results of the final research question investigating individual differences in the verbal mediation of behaviour, will be presented in this chapter. Results discussed in this chapter came from the data collected during the classroom recordings as well as the laboratory-based 'tidy-up' task. The eight children in the study were initially divided into two groups (*high* and *low*) on the basis of their frequency of t-patterns comprising private speech, a measure which could be assumed to indicate the frequency with which the children deployed verbal mediation of behaviour. Through the qualitative analysis carried out in the chapter, the children were found to mostly belong to the same group for other measures related to patterned use of speech together with goal-related behaviours, successful self-regulation during goal-directed episodes and performance in the 'tidy-up' task. This enabled an approximate division of the children into two groups, for the sake of further qualitative analysis. The qualitative analysis carried out subsequently, revealed qualitative differences in the level of self-regulation employed by the children of the two groups. The summary at the end of the chapter highlights the important contributions made by these findings to the research on private speech and self-regulation in young children.

Research Question 3: Are there any consistent individual differences in the verbal mediation of behaviour through private speech?

Hypothesis: Children would differ consistently, both quantitatively and qualitatively, in their level of verbally mediated self-regulation during goal-directed episodes, both in the classroom and the laboratory. Qualitatively, a higher level of verbally mediated self-regulation would involve more frequent and unique types of temporal patterns comprising task-relevant speech and goal-related behaviour. Whereas, qualitatively, it would be expressed in more sophisticated forms of self-regulation involving monitoring for error and error correction.

7.2 Summary of Analysis

The final research question enquired whether the children displayed consistent individual differences in the ways in which they verbally mediated behaviour across the two settings (classroom and laboratory) wherein their goal-directed behaviour and speech was observed. As discussed earlier in the results obtained for the second research question, recurring temporal co-incidences between goal-relevant speech and behaviours found within t-patterns did not represent direct evidence of actual verbal mediation of behaviour, unless the individual t-patterns obtained were contextually analysed and revealed meaningful episodes of verbal mediation of behaviour in real-time. However, the t-patterns thus obtained are certainly a step forward from the correlations between speech and behaviour obtained from the same data, by indicating a more concrete real-time temporal interaction between speech and behaviour. Hence, two types of data analyses were carried out in relation to this research question. The first type of analysis was quantitative in nature and dealt with t-pattern parameters obtained from the children's behaviour in the classroom and the laboratory and their relation with other measures of self-regulation, performance and speech production calculated for the two settings. Ideally, correlation between the various measures obtained from the individual children in the classroom and the laboratory, would have indicated the presence of consistent individual styles of verbal mediation across the two settings. However, due to the small number of subjects in the study, it was not possible to reliably conduct statistical tests. Hence, instead of comparing individual scores or ranks, the 8 children were divided into 2 groups — a top and a bottom half, based on their performance on each of the measures used in the comparison. Consistency of individual differences was then examined through the consistency of the children belonging to the same group across the different measures. Frequency of t-patterns comprising speech in the classroom was primary measure of grouping the children into a *high* and *low* group. The second type of analysis involved qualitative analyses of the t-patterns comprising speech and behaviour obtained from the two groups of children across the two settings in order to assess individual styles adopted by the two groups of children in the verbal mediation of behaviour.

7.3 Quantitative Analysis

The first type of analysis examined whether children divided into a high and a low group on the basis of the primary measure of frequency of t-patterns of behaviour with speech (or frequency of speech patterns) continued to stay in the same group for another measure of patterned behaviour involving speech, measure of speech production or talkativeness, self-regulation and task performance. The various measures used for making these comparisons are described below, followed by the analysis where the consistency of group membership between the primary measure (frequency of speech patterns) and each of the other measures is examined.

7.3.1 Quantitative measures

Seven numerical measures were obtained from the behaviour of the children in the classroom as well as their performance in the laboratory-based task. Two of the measures were obtained from the t-pattern analysis of the data recorded in the classroom. The third was a measure of talkativeness in the classroom, to examine whether measures related to speech were simply a reflection of the total verbal output of the child or were they more specific to strategic verbal mediation, irrespective of the rate of speech production. The next two measures were related to self-regulatory behaviour exhibited by the children throughout a goal-directed episode and were computed on the basis of goal-related behaviours observed in the classroom as well as the laboratory. The sixth measure calculated the performance score for the laboratory-based 'tidy-up' task. The final measure was a composite score for the 'tidy-up' task in the laboratory, combining both the self-regulation score in the laboratory as well as the task performance score. The first speech-related measure was used to group the children into the two groups, namely, the high and the low group. The consistency of individual differences was examined by checking whether the children who belonged to the initial groups (high or low) for the first measure continued to belong to the same group for the rest of the measures. The seven measures used in the quantitative analysis for making group-wise comparisons are described in the sections below.

7.3.1.1 Frequency of speech patterns

In order to calculate measures obtained through t-patterns, a t-pattern search within the goal-directed episodes in the classroom per child was carried out. Hence various episodes belonging to the same child were collapsed together to form a single dataset for that child, from which t-patterns were extracted. This was repeated for all the eight children, for the data obtained from the

classroom recordings. The following search parameters were used to initiate each of the t-pattern searches: **minimum occurrences** (minimum number of times a t-pattern must occur to be detected) = 10, **significance level** (maximum accepted probability of any critical interval relationship to occur by chance) = 0.005 and **minimum samples** (percent of samples or observations in which a pattern must occur to be detected) = 20%.

The search resulted in several t-patterns for each child, of which only a certain proportion of t-patterns also contained goal-relevant speech in them along with goal-relevant behaviours. These will be henceforth referred to as the *speech patterns*. The presence of these speech patterns specifically indicated a possible deployment of verbal mediation of behaviour as a strategy for achieving goals in a naturalistic setting. This may be the case as opposed to the use of other non-verbal strategies during goal attainment which might be present in the non-speech t-patterns. Due to the specific aim of examining the verbal mediation of behaviour in this study and its limited scope, only measures related to speech patterns were considered from the results obtained from t-patterns. Hence the primary measure according to which the 8 children were ranked was the total number of *speech pattern* occurrences that were extracted from the classroom observations. Since the patterns were derived from a varying number of speech utterances per child (due to differences in talkativeness as well as varying durations of observation), the number of speech pattern occurrences for each child was divided by the total number of speech utterances recorded for that child. The resulting metric will be henceforth referred to as the *frequency of speech patterns*. The four top ranking children with the highest frequency of speech patterns were placed in the *high* group, while the remaining four children were categorised under the *low* group. **Table 7.1** shows the children categorised into the two groups.

It may be noted in **Table 7.1** that no t-patterns could be extracted from the classroom observations recorded for Child 2. This could be because one of the search parameters for the t-pattern search, namely the minimum number of occurrences per pattern, was set considerably high at 10. Since the duration of observation recorded for Child 2 was the shortest, the search could not reveal patterns that occurred less frequently in Child 2. A lower value for this search parameter may have revealed some patterns in Child 2's behaviour, albeit of lower frequency.

7.3.1.2 Number of unique speech patterns: PattDiff_speech

While the first measure was based on the total number of occurrences of all speech patterns, the second measure was based on the number of unique speech patterns observed in each child in the classroom. This was termed *PattDiff_speech* and represented the unique recurring combinations of speech and behaviour indicative of the number of unique and different examples of verbal mediation of behaviour.

7.3.1.3 Measure of talkativeness

A measure of talkativeness in the classroom was included in the analysis in order to check whether the other speech-related measures were simply a reflection of the rate of speech production, or whether they were unrelated to the amount of speech produced, and more indicative of verbal mediation of behaviour, dependent upon a fixed timing in conjunction with relevant behaviour. This measure was calculated as the rate of goal-relevant speech produced in the classroom per minute for each child.

7.3.1.4 Self-regulation score_class

The *self-regulation score_class* (*SR score_class*) for each child was derived from certain types of goal-related behaviours in the classroom. This measure was computed as a ratio of instances of successful self-regulation to instances of failures of self-regulation, observed in the behaviour of a child during a goal-directed episode in the classroom. These instances of self-regulation were not single events, but were rather identified as particular sequences of goal-related behaviours that arose during moments of difficulty and either aided in the achievement of the goal (successful self-regulation) or proved detrimental to goal-attainment (failures of self-regulation). Three types of successful self-regulation were derived from the coded behaviour, namely, *overcome distraction, goal appraisal* and *error correction.* Four types of failures of self-regulation identified in the behaviour were, *distractedness, quitting behaviour, externally regulated* and *perseveration.* It may be noted that very often the same behaviour occurred both in a sequence representing successful self-regulation as well as in a sequence representing a failure of self-regulation. However, it was the context in which such a behaviour occurred along with other behaviours, which determined whether it was a success or a failure of self-regulation. The sequences of behaviour in each of these instances is described below.

(A) _Overcome distraction_: This was an instance of successful self-regulation, wherein a child was initially distracted from the task at hand and as a consequence, left the ongoing goal pursuit. However the child soon managed to return to the previous goal pursuit and hence was able to demonstrably overcome the distraction encountered earlier and return to task. Such an instance was counted as one episode when the following three behaviours were exhibited by a child consecutively within a goal-directed episode — **distraction, leave goal pursuit** and **return to previous goal.**

(B) _Goal Appraisal_: Another instance of successful self-regulation again involved the seemingly negative behaviour of _leave goal pursuit_. Contextual analysis of this event showed that _leave goal pursuit,_ when preceded by a _failed strategy_ or a _failure to attain goal_ and followed immediately by a _new goal pursuit,_ indicated a reassessment of one's ability to achieve a difficult goal followed by a change or adaptation from the previous goal to a more manageable new goal. Such adaptive behaviour has been referred to in the emotional self-regulation literature as 'reappraisal' (Gross, 1998; Gross, 2001), a successful strategy of down-regulating negative emotions by carrying out cognitive re-evaluation of a potentially emotion-eliciting situation, such as a failure to attain a goal. The strategy of adapting a present unachievable goal to a more achievable one or to divert oneself and pursue an entirely new goal might be a strategy being used by some children to preemptively avoid disappointment related to failure, especially in a naturalistic context, where goals have been self-initiated. Hence when seen in context, the following sequence of events actually pointed towards an instance of successful self-regulation, referred henceforth as _goal appraisal:_ **failed strategy** or **failure to attain goal, leave goal pursuit** immediately followed by **new goal pursuit.**

(C) _Error correction:_ The third type of successful self-regulation involved repeatedly performing a failed strategy and then reviewing the task progress or detecting one's error followed by changing one's strategy to reach a successful outcome. Such a sequence of behaviour is commonly identified in the self-regulation literature as the result of successful monitoring behaviour (Pintrich, 2000), wherein error detection is followed by a change in behaviour aimed at correcting one's error and attaining one's goal through another strategy. The sequence of events representing _error correction_ within a child's behaviour were as follows: **repeat failed strategy, check progress** or **notice error/issue, change strategy.** It may be noted that a single occurrence of failure in the form of a _failed strategy_ was not counted as enough evidence of an error or obstacle in goal-attainment, since this failure could simply be a result of the nature of the task and beyond the control of the child. Repeated occurrences of failure which initially went

uncorrected, pointed to a more decisive example of failure or obstacle met by the child. Hence only *repeat failed strategy* was counted as erroneous behaviour requiring correction in the sequence of behaviours representing *error correction*.

(D) <u>*Distractedness:*</u> The first type of failure of self-regulation involved leaving the pursuit of the ongoing goal after being distracted from the task, by some external event. Unlike *resist distraction* as an example of successful self-regulation, there was no return to the previous goal pursuit, and the child mostly left the pursuit of the goal and got involved in another activity. The sequence of events representing *distractedness* in a child's behaviour were as follows: **distraction, leave goal pursuit.**

(E) <u>*Quitting:*</u> The second type of failure of self-regulation involved leaving the pursuit of the ongoing goal after facing failure in the task, either in the form of failure of a goal-oriented strategy or the ultimate failure in attaining the goal. Unlike *goal appraisal,* wherein a new goal pursuit was immediately taken up by the child after leaving the previous goal, the child usually left any further goal-directed activity all together in *quitting*. Hence while the former was an example of successful self-regulation representing a coping strategy by reassessing one's ability and pursuing a more suitable goal to avoid disappointment, the latter was an example of a failure of self-regulation in which after facing an obstacle in the task, the child did not make any effort to either change one's strategy to achieve the goal or change the goal itself. The sequence of events representing *quitting* in a child's behaviour were as follows: **failed strategy** or **failure to attain goal** and **leave goal pursuit.**

(F) <u>*Externally regulated:*</u> The third type of failure of self-regulation was similar *quitting*, in that it also involved leaving the pursuit of the ongoing goal. However in this case, the reason for leaving the goal was not one's own failure, but instead, an external disruption in the task or being regulated by another child in a way which obstructed the pursuit of the goal. Hence the child's behaviour was regulated by some external event, which the child was not able to manage and circumvent and hence left the goal pursuit as a result of it. The sequence of events representing *externally regulated* in a child's behaviour were as follows: **disruption** or **regulated by other** and **leave goal pursuit.**

(G) <u>*Perseveration:*</u> The final type of failure of self-regulation involved repeating a failed strategy several times without recognising the inappropriateness of the strategy and not applying a new strategy instead and hence failing to attain the goal ultimately as a result of this persistence. Such a behaviour has been recognised in the self-regulation literature as a failure of control

processes (Deak & Narasimham, 2003; Bryce & Whitebread, 2012), wherein the child fails to inhibit the incorrect response and does not act flexibly to respond differently. The sequence of events representing *perseveration* in a child's behaviour were as follows: ***repeat failed strategy*** and ***failure to attain goal.***

Hence, all of the above instances of self-regulation (success and failure) were counted in each child's behaviour during the goal-directed episodes in the classroom, and the *SR score_class* was calculated for each child by dividing the sum of all successful self-regulation instances by the sum of all failures of self-regulation.

The formula for calculating this score is depicted below.

Self-regulation score_class = Success / Failure ratio = (A+B+C) / (D+E+F+G)

wherein,

A = Overcome distraction	D = Distractedness
B = Goal appraisal	E = Quitting
C = Error correction	F = Externally regulated
	G = Perseveration

The number of instances of self-regulation (success and failure) observed in each child in the classroom and the *SR score_class* calculated as the success to failure ratio per child is tabulated in **Table 7.2.**

Table 7.2. Self-regulation score_class obtained for each child as the ratio of instances of success to instances of failure of self-regulation.

Child	self-regulation_success			self-regulation_failure				SR score _class
	Overcome distraction	Goal appraisal	Error correction	Distractedness	Quitting	Externally regulated	Perseveration	
child 1	0	0	1	0	2	0	1	0.33
child 2	0	0	3	0	1	1	0	1.5
child 3	7	5	4	4	4	0	2	1.6
child 4	2	5	9	0	1	0	0	16
child 5	2	1	4	4	3	1	0	0.88
child 6	4	7	4	0	3	0	0	5
child 7	4	0	4	2	1	0	0	2.67
child 8	5	1	0	0	1	4	1	1

7.3.1.5 Self-regulation score_lab

The *self-regulation score_lab* (*SR score_lab*) was calculated in the same manner as the *SR score_class* described in the previous section, but comprised an additional type of failure of self-regulation, namely, *goal neglect*. This was incorporated to take into account the fact that the 'tidy-up' task had clear rules to be followed in order to attain a pre-defined goal. This type of behaviour could not be identified in the goal-directed episodes in the classroom, since the goals being pursued by the children in this case were set by the children themselves and kept changing or evolving as per the context. Hence it was difficult to define fixed rules that needed to be followed to attain the goal in the classroom setting. Therefore, those instances wherein a child ignored a task rule were identified as instances of *goal neglect.* The various rules governing the tidy-up task are described in the next section, when the calculation of the task performance score is described. The formula for calculating the *self-regulation score_lab* after incorporating *goal neglect* is depicted below.

Self-regulation score_lab = Success / Failure ratio = (A+B+C) / (D+E+F+G+H)

wherein,

A = Overcome distraction	D = Distractedness
B = Goal appraisal	E = Quitting
C = Error correction	F = Externally regulated
	G = Perseveration
	H = Goal neglect

The number of instances of self-regulation (success and failure) observed in each child in the laboratory and the *SR score_lab* calculated as the success to failure ratio per child is tabulated in **Table 7.3.**

Table 7.3. Self-regulation score_lab obtained for each child as the ratio of instances of success to instances of failure of self-regulation.

Child	self-regulation_success			self-regulation_failure					SR score _lab
	Overcome distraction	Goal appraisal	Error correction	Distractedness	Quitting	Externally regulated	Perseveration	Goal neglect	
child 1	0	0	2	1	1	0	2	3	0.29
child 2	0	0	2	0	1	1	3	5	0.20
child 3	1	0	0	0	0	0	0	5	0.20
child 4	0	3	2	0	0	0	0	7	0.71
child 5	0	0	1	0	0	1	0	4	0.20
child 6	1	0	6	0	1	0	0	3	1.75
child 7	0	0	3	0	1	0	0	6	0.43
child 8	0	2	1	0	0	4	1	4	0.33

7.3.1.6 Task performance score

While the *SR score_lab* was based on the goal-related behaviours exhibited by each child in the laboratory during the process of self-regulation, the *task performance score,* as the name suggests, was the only measure in this analysis which was based on the end product of self-regulation, i.e., the performance of the child in the various components of the 'tidy-up' task. Hence the final score was an aggregate of the score obtained in the various sub-parts of the task. The task involved sorting an assortment of red, blue and yellow-coloured Duplo bricks and pieces and filling them into three boxes of descending size. All the red pieces fitted inside the large box (L), the blue inside the medium-sized box (M) and the yellow pieces inside the smallest box (S). The boxes came with clip-on lids, and the participants were supposed to close the boxes with their respective lids. Hence they were required to arrange the pieces in such a way that the lid could be closely fitted and the box could be closed. Thus the task comprised two parts: *fill_box* and *close_box*. Participants were scored separately on both parts of the task, since many of them did not attempt both the parts for every box. In order to systematically score the performance of all the children on the task, the two parts of the task were further broken down into a set of rules which had to followed to complete each part of the task successfully. The rules for each part of the task are listed below in **Table 7.4.**

Table 7.4 Rules to be followed for each of the two parts of the 'tidy-up' task: fill_box and close_box.

Rule	Fill_box	Close_box
rule 1 (correct box)	Choose correct-sized box	Choose correct-sized box
rule 2 (all pieces in)	Put all pieces of one colour together in one box, not leave some out	Put all pieces of one colour together in one box, not leave some out
rule 3 (pieces fit in)	All pieces should fit inside the box, pieces should not poke out of the box	All pieces should fit inside the box, pieces should not poke out of the box
rule 4 (colours not mixed)	Not mix colours, pieces of other colour should not be placed in the box	Not mix colours, pieces of other colour should not be placed in the box
rule 5 (lid fits)	-	Choose correct-sized lid to close the box

Very few participants followed all the rules of a task component. This was expected, since the task was designed to be difficult and slightly above the ability of a four to five-year-old, in order to elicit more speech during the task completion. Keeping the task at an optimum level of difficulty has been suggested by many studies in the private speech literature, since it evokes a greater amount of speech than a very easy or a very difficult task (Kohlberg et al., 1968; Behrend et al., 1989; Duncan & Pratt, 1997; Fernyhough & Fradley, 2005). Hence children were scored on the number of rules that they managed to follow while attempting the task, rather than scoring them at the end for a single variable of pass or fail. Moreover, since many children did not complete or even attempt both parts of the task for every box size, four of the rules were common for both *fill_box* as well as *close_box,* which traced all relevant but common actions that would have been carried out for completing either part of the task. The scores were assigned at the end of each of the six task components: *fill_box* and *close_box* for each of the three box sizes, large (L), medium (M) and small (S). Hence, for example, when the participant finished closing the medium-sized box (close_box(M)) and moved on to filling the large-sized box (fill_box(L)), the score for close_box(M) was assigned. On several occasions, the participants reorganised a box that they had already filled or closed. In such cases, the final score was revised and assigned on the basis of the last action carried out upon the box. Scores were assigned for the number of rules that were successfully followed by the participant out of the total number of rules to be followed for that task component. If the participant followed all the rules for close_box(M), she received 5/5 at its completion, while if only three of the rules for fill_box(L) were adhered to, the participant received 3/4 at its completion. The scoring pattern for both parts of the task is tabulated below in **Table 7.5**.

Table 7.5 Scoring pattern for the two parts of the 'tidy-up' task: fill_box & close_box

Fill_box	Close_box
All 4 rules followed: 4/4	All 5 rules followed: 5/5
Any 3 rules followed: 3/4	Any 4 rules followed: 4/5
Any 2 rules followed: 2/4	Any 3 rules followed: 3/5
Any 1 rule followed: 1/4	Any 2 rules followed: 2/5
Failure to attain goal: 0	Any 1 rule followed: 1/5
	Failure to attain goal: 0

Since half of the children participated in the task as a dyad, and some of them divided the different components of the task between themselves, all children did not attempt all the six components of the task. Hence the task performance score was calculated as the sum of scores obtained on each of the six task components, divided by the number of task components attempted by the participant, either individually or as a dyad. Those task components which the participants could not carry out successfully and for which they asked for assistance from the researcher were also counted as attempted by the participant. However those components were assigned a zero score. At times, a zero score was also assigned for a task component which was unsuccessfully attempted by the participant and then passed on to the other child in the dyad to complete.

Hence the *task performance score* was calculated as follows:

Task performance score= [fill_box(L+M+S) + close_box(L+M+S)] / no. of components attempted

The scores obtained by each child in each of the six task components and their individual *task performance scores* are tabulated in **Table 7.6.**

Table 7.6. Scores obtained by each child in each of the 6 task components of the 'tidy-up' task and the task performance score calculated by dividing their sum by the number of task components attempted by the child

Child	Fill_box score			Close_box score			no. of components attempted	task performance score
	L	M	S	L	M	S		
child 1*	2/4	2/4	0 (a)	4/5	2/5	0 (a)	6	0.36
child 2*	3/4	3/4	0 (a)	(oc)	2/5	0 (a)	5	0.35
child 3*	3/4	3/4	3/4	(oc)	3/5	3/5	5	0.69
child 4	0 (a)	2/4	3/4	4/5	0	4/5	6	0.47
child 5	3/4	0 (a)	2/4	4/5	0 (a)	3/5	6	0.44
child 6	0 (a)	0 (a)	2/4	0 (a)	0 (a)	0 (a)	6	0.08
child 7	3/4	3/4	2/4	0 (a)	4/5	0 (a)	6	0.46
child 8*	3/4	0 (oc)	3/4	4/5	0 (oc)	0 (oc)	6	0.38

L = large box; M = medium box; S = small box; * = working in a dyad; (a) = adult assistance; (oc) = attempted by the other child in the dyad

7.3.1.7 Total lab score

The final measure was based on the aggregate of self-regulatory behaviour and task performance during the laboratory-based 'tidy-up' task. Hence the *total lab score* for each child was computed as the sum of the *SR score_lab* and the *task performance score*. The final scores obtained by each child are tabulated in **Table 7.7** below.

Table 7.7. Total lab score computed as the sum of the SR score_lab and the task performance score, based on the behaviour of each child in the 'tidy'up' task

Child	SR score_lab	task performance score	total lab score
child 1*	0.29	0.36	0.65
child 2*	0.20	0.35	0.55
child 3*	0.20	0.69	0.89
child 4	0.71	0.47	1.18
child 5	0.20	0.44	0.64
child 6	1.75	0.08	1.83
child 7	0.43	0.46	0.89
child 8*	0.33	0.38	0.71

7.3.2 Consistency between measures

As mentioned earlier, *frequency of speech patterns* was taken as the primary metric of comparison, and the two groups that this metric gives rise to, namely, the *high* and *low* groups (see **Table 7.1**), formed the basis for comparing the consistency of the children in belonging to the same group for each of the other measures described above. The scores of the participants for each of the seven measures are reported in **Table 7.8..**

Table 7.8 Individual scores of the 8 participants obtained in seven different measures, with the four top ranked scores highlighted in green and the bottom ranked scores highlighted in red

child	frequency of speech patterns	PattDiff_speech	measure of talkativeness	self-regulation score_class	self-regulation score_lab	task performance score_lab	total lab score
Child 7	4.37	65	14.22	2.67	0.43	0.46	0.89
Child 6	3.85	39	6.00	5.00	1.75	0.08	1.83
Child 4	2.99	55	6.67	16.00	0.71	0.47	1.18
Child 3	2.09	22	6.58	1.60	0.20	0.69	0.89
Child 8	1.59	19	10.01	1.00	0.33	0.38	0.71
Child 5	0.42	4	8.31	0.88	0.20	0.44	0.64
Child 1	0.19	1	6.97	0.33	0.29	0.38	0.65
Child 2	0	0	8.65	1.50	0.20	0.35	0.55

7.3.2.1 Comparison with PattDiff_speech

Comparison of the *frequency of speech patterns* with the next measure in **Table 7.8**, namely, *PattDiff_speech*, showed that all the children who exhibited higher frequency of speech patterns also exhibited higher number of unique speech patterns. This might indirectly indicate that those children who more frequently employed some form of verbal mediation of behaviour as a goal-attainment strategy also exhibited a higher number of different kinds of verbal mediation of behaviour.

7.3.2.2 Comparison with measure of talkativeness

The next comparison with the *measure of talkativeness* (rate of all goal-relevant speech per minute) revealed a trend of reversal of group memberships, with the most talkative children (except for Child 7) falling under the low group for frequency of speech patterns, and the relatively less talkative children (except Child 1) exhibiting higher frequencies of patterns comprising speech. Hence, it could be inferred that the larger frequency of speech patterns extracted from a child's behaviour in a goal-oriented episode is in fact indicative of a fixed temporal relationship between speech utterances and goal-relevant behaviours rather than a mere abundance of speech utterances found in the child's behaviour. However, the reversal of group membership was not absolute for this measure, since two of the children did not follow this trend. Nonetheless, the results obtained for the rest of the children do indicate that the patterned temporal relations between speech and behaviour, seem to be playing a crucial role rather than the mere quantity of speech.

7.3.2.3 Comparison with measures of goal-directed behaviour

Finally group comparisons were made with the self-regulation and performance-oriented measures. The *self-regulation scores* (*SR score_class* & *SR score_lab*) and the *task performance score* were not static measures of goal-attainment or performance assessed at the end of an episode or task. Instead, they represented dynamic measures of goal-directed behaviour. The *self-regulation scores* were calculated by assessing different types of self-regulation exercised during spontaneous moments of difficulty occurring throughout a goal-directed episode. The *task performance score* was a graded score awarded to a child on his or her performance across those sub-components of the task which the child attempted to solve. Hence consistent group memberships between *frequency of speech patterns* and these measures of goal-directed behaviour might be a strong indicator of a relationship between the frequent use of verbal mediation as a goal-directed strategy and successful self-regulation exhibited during goal-directed episodes, both in the classroom as well as in the laboratory. The comparison of group membership between the *frequency of speech patterns* and the *SR score_class* indeed showed consistent group memberships of all the children between the two measures.

However comparisons with the next two measures obtained in the laboratory did not show consistent group membership for all the children. Child 3 who originally belonged to the *high* group for the measure of *frequency of speech patterns,* appeared in the *low* group for the measure of *SR score_lab*. On the other hand, Child 8 who originally belonged to the *low* group for the measure of

frequency of speech patterns, appeared in the *high* group for the measure of *SR score_lab.* When comparing group memberships between *frequency of speech patterns* and *task performance score,* Child 6 who originally belonged to the *high* group for *frequency of speech patterns,* appeared in the *low* group for the measure of *task performance score,* with the lowest score amongst all the children. On the other hand, Child 5 who originally belonged to the *low* group for *frequency of speech patterns,* appeared in the *high* group for *task performance score,* albeit with the lowest score amongst the top four children. Hence absolute consistency of group membership for all the children cannot be claimed for these two measures obtained from the laboratory. However, when these two scores were combined into the composite of the *total lab score,* comparison with the *frequency of speech patterns* showed consistent group memberships for all the children. This happened because some children exhibited successful self-regulation in the laboratory, but did not manage to solve all components of the task successfully (Child 6 and Child 8), in the task, while some children did not display many instances of successful self-regulation, yet managed to score well in the task (Child 3 and Child 5). Although these variations evened out their scores when aggregated into the *total lab score,* it is important to note that level of performance displayed by a child in a task may not always correspond to the degree of successful self-regulation employed by the child while solving the task. Thus, overall goal-directed behavior in the laboratory indicated by the *total lab score*, as a combination of successful self-regulation as well as successful task performance, was consistently displayed by the children in comparison to the *frequency of speech patterns* detected in their goal-directed behaviour.

It may also be noted that group membership between the *SR score_class* & *total lab score* was consistent for all the children. This indicates that an underlying goal-directed aptitude was measured for each child through the behaviour-related scores obtained in the classroom and the laboratory.

7.3.2.4 Conclusion

The quantitative analysis carried out above demonstrated that the children initially grouped into the *high* and the *low* groups, based on the *frequency of speech patterns,* mostly stayed in the same group (high or low) for the other verbal and behavioural measures in the classroom and the laboratory, except for the measure of talkativeness which saw a modest trend of reversal of group membership. It may be noted that group membership for the two behavioural measures (*SR score_lab* and *task performance score*) obtained from the laboratory did not show absolute

consistency, mainly due to idiosyncratic behaviour of some of the children in the 'tidy-up' task, wherein two children displayed successful self-regulation with a relatively poor performance in solving the task, while another two children displayed the opposite trend.

If we consider the initial measure of *frequency of speech patterns* to indicate the frequency of deployment of verbal mediation of behaviour as a strategy for achieving goals in the naturalistic setting, then the modest consistency of group membership when compared with the other measures indicates that the two groups of children displayed some group differences in the prevalence of verbal mediation of behaviour, as well as degree of successful self-regulation in the classroom and the laboratory and performance level in the 'tidy-up' task. However, due to the small number of children, claims cannot be made regarding a normative trend in the data. However, for the sake of further qualitative analysis in this study, such a method of quantitative analysis enabled a division of the children into two groups, who were approximately consistent in their frequency of verbal mediation of behaviour as well as display of successful goal-directed behaviour. Henceforth, in all further analyses, the division of the children into the *high* and the *low group (*based on the initial measure of *frequency of speech patterns*), were also taken to represent groupings on the basis of their level of self-regulation during goal-directed behaviour. Since the group memberships were consistent across measures from the classroom (*SR score_class*) and the laboratory (*total lab score*), the two groups were considered valid for both the classroom and the laboratory.

7.4 Qualitative Analysis

The qualitative analysis, carried out next, examined the differences in the style of verbal mediation of behaviour, between the two groups, for the classroom and the laboratory settings separately. In the beginning, t-pattern searches were conducted within the classroom and the laboratory datasets. In each t-pattern search, the dataset was divided into episodes from children in the *high group* (Child 3, 4, 6 & 7) and the *low group* (Child 1, 2, 5 & 8). The searches extracted several t-patterns in both the datasets, for each of the two groups. Since the focus of subsequent analyses was on the verbal mediation of behaviour, only those patterns which contained a private speech utterance were selected. Out of these private speech patterns, top five private speech patterns were selected in descending order of *duration across the dataset* for the *high* and the *low group,* from the classroom and the laboratory dataset. After this, two types of quantitative analyses were carried out with the selected speech patterns. The first type of analysis was a *comparative analysis* between the selected t-patterns belonging to the two groups, wherein qualitative attributes of the patterns such as the

presence of goal-directed behaviours unique to a particular group and the temporal relationship of these unique behaviours with adjacent private speech utterances was examined. The comparisons revealed certain qualitative differences between the t-patterns extracted from the two groups. A few t-patterns which were most illustrative of these differences between the two groups were further selected for a detailed *contextual analysis*. This involved examining the real time context in which one instance of a selected t-pattern occurred within its dataset. The analysis carried out here was similar to the contextual analysis carried out in the previous chapter (**Section 6.7**). This revealed qualitatively different styles and levels of verbally mediated self-regulation employed by the children in the *high* and the *low group,* thus corroborating the findings from the quantitative analysis carried out in **Section 7.2.**

7.4.1 T-pattern search

Two separate t-pattern searches were initiated, within the classroom and the laboratory datasets, respectively. In each search, t-patterns were extracted from the combined dataset of all the children belonging either to the *high group* or the *low group*. The t-pattern search for the data obtained from the classroom had the following search parameters: **minimum occurrences** (minimum number of times a t-pattern must occur to be detected) = 10, **significance level** (maximum accepted probability of any critical interval relationship to occur by chance) = 0.005 and **minimum samples** (percent of samples or observations in which a pattern must occur to be detected) = 40%. The same parameters were used for the t-pattern search for the laboratory data, except for the last parameter of **minimum samples,** which was set at 100%. The significance of this parameter is that the t-patterns detected in this search were necessarily found in all the samples (100%) of the laboratory dataset, i.e. in each of the four children belonging to either the *high* or the *low group*. The parameter could not be kept the same for the classroom dataset, because at 100% the search in the classroom data did not reveal many unique t-patterns in the *high* and the *low group*. Hence the parameter was set at an optimum level of 40%. This could be explained by the different nature of activities recorded in the two settings. While the laboratory data only comprised the 'tidy-up' task carried out individually or in a dyad, the classroom data captured a diverse range of child-initiated activities in the classroom, in the presence of others. Hence a certain degree of uniformity of action sequences was evident in the laboratory data, whereas the classroom data comprised action sequences of varying content, length and people involved.

7.4.2 Selection of private speech patterns

The two searches revealed various t-patterns for the two groups in the classroom and the laboratory setting. Out of these patterns, speech patterns (t-patterns comprising speech events) obtained from the *high group* and the *low group* were selected for further analysis, since the focus of the analysis was on verbal mediation of behaviour. Speech patterns from the *high* and the *low group* were compared on the basis of the different goal-related behaviours that co-occurred with private speech in the two groups. In both sets of analysis (classroom and laboratory), the goal-sharing context was not taken into account, and the data recorded in each setting was only divided into the *high* and *low* group, across all types of goals, namely the personal and the shared goals. This was done because all children in the two groups did not display equal amounts of behaviour in both types of goal-sharing contexts. This was more so the case in the data obtained from the laboratory wherein half of the children attempted the 'tidy-up' task in the solitary condition only. Hence they could not demonstrate any goal-related behaviour governed by shared goals. For the same reason, social speech occurrences were excluded from the analysis, and only private speech occurrences within t-patterns were considered, since those children who carried out the task in the solitary condition had no opportunity to produce any social speech. The private speech utterances were not further divided into the nine pragmatic categories of speech, since the dataset for each of these searches was not large enough to reveal t-patterns with individual speech categories.

The number of unique t-patterns detected by the searches in the classroom and the laboratory datasets are reported in **Table 7.9**. Out of these t-patterns, those containing private speech along with behaviour were selected for further analyses, which are also mentioned in **Table 7.9.** Another metric, termed as **n_mean**, stands for the mean number of occurrences per pattern. This metric along with its standard deviation value for the private speech patterns are also mentioned in the table. It may be noted that although unique private speech patterns were more in number in the *low group* when compared to the *high group* in the classroom as well laboratory datasets, the mean occurrences per speech pattern (n_mean) was significantly higher for the *high group* in comparison to the *low group,* in both the settings (classroom: p<.0001, t = 6.19; laboratory: p = .03, t = 2.32). Hence, while it may seem that the children in the *high group* did not have as many different types of patterned behaviour involving private speech as the children in the *low group,* the unique t-patterns which their behaviour did exhibit were more frequent than those in the *low group,* in both the settings.

Table 7.9 Results of the t-pattern search across the classroom and laboratory datasets, for the high and the low groups. Mean number of occurrences per speech pattern are also provided along with their standard deviation.

	Classroom		Laboratory	
Group	High	Low	High	Low
# of unique patterns	243	190	116	227
# of unique private speech patterns	12	21	8	14
n_mean for speech patterns (std. dev)	46.5** (14.1)	18.5 (11.5)	18.2* (10.2)	12.7 (2.5)

**= p<.01; * = p<.05

Selection of five speech patterns from each group

For a detailed comparison of the private speech patterns between the *high* and the *low group,* selection of a few patterns was required based on a suitable criterion. Many of the speech patterns occurred very infrequently in the dataset, while others were frequent but short in length, i.e. not comprising many events. While the first type of patterns might not be representative of the entire dataset due to their infrequent occurrences, the second type of patterns might not be able to capture a sequence of behaviour unique to that group, due to the small length of patterns which could be very frequently seen in both the groups. An optimum selection criterion was required which would pick up those patterns which were frequent enough to be representative of the entire group's behaviour, while showcasing patterned behaviour which was unique to that group. Hence, the measure of *duration across the dataset* (i.e., total duration of all occurrences of the t-pattern as a percentage of the total duration of the dataset) was taken as the criterion for selecting the top five private speech patterns for the *high* and the *low group*. The measure of *duration across the dataset* was chosen as the basis for selecting the t-patterns, instead of measures such as *pattern length* (number of events in a pattern) or *pattern frequency* (number of occurrences of the pattern in the dataset). This was an optimum measure, in between pattern length and pattern frequency, incorporating both the longest and most frequent patterns. The patterns selected with the longest durations would most often have a larger number of events in the pattern, and hence involve patterns with high pattern lengths, while avoiding those long patterns which were otherwise very infrequent in the dataset. At the same time, the selected patterns were also one of the more frequently occurring patterns in the dataset, as they covered a longer duration of the dataset, while avoiding those highly frequent patterns which were otherwise very short in pattern length and hence

spanned a small duration of the dataset. Hence the five patterns selected in descending order of *duration across the dataset* were representative to a certain extent of the unique styles of verbal mediation exhibited by each group. Further comparative analysis (see **Section 7.4.3)** of these selected patterns from each group was conducted, for the classroom and the laboratory datasets.

7.4.3 Comparative analysis of private speech patterns

A comparative analysis of the private speech patterns belonging to the *high* and the *low group,* across the two settings was conducted. In the first step of the analysis, comparison between the two groups was made on the basis of behaviours present in the selected t-patterns, which were unique to that group. In the second step of the analysis, comparison between the two groups were made on the basis of the temporal relation between the unique behaviours in each group and the private speech utterances adjacent to these behaviours.

Based on these highlighted qualitative differences between the *high* and the *low group,* one or more t-patterns were selected from each group, which were illustrative of these differences. In the final step of the qualitative analysis (see **Section 7.3.4)**, the selected t-patterns were contextually analysed, by examining one instance of their occurrence in the dataset involving a child from the concerned group. This enabled a comparison of the styles of verbal mediation of behaviour in real-time, adopted by the two groups of children.

7.4.3.1 Presence of behaviours unique to a group

Classroom

The top five private speech patterns extracted from the classroom data, in descending order of *duration across the dataset* for the *high* and the *low group* are shown in **Fig. 7.1**. For clearer visualisation, the private speech utterances occurring in a t-pattern which are followed by another event in the t-pattern are highlighted in red, while the private speech utterances which occur at the end of a t-pattern are given in blue. The first qualitative attribute of the t-patterns in **Fig. 7.1** which differs between the two groups is the presence of monitoring behaviours (***notice issues/error*** and ***check progress***) in the *high group* only. On the other hand, patterns in the *low group* often comprise behaviours which map the course of a goal-directed episode (e.g., ***new goal pursuit***).

HIGH GROUP:

LOW GROUP:

high_class_Pattern 1

(01) routine strategy
(02) private speech
(03) routine strategy

low_class_Pattern 1

(01) routine strategy
(02) private speech
(03) routine strategy

high_class_Pattern 2

(01) notice issue/error
(02) private speech
(03) change strategy

low_class_Pattern 2

(01) new goal pursuit
(02) private speech
(03) routine strategy

high_class_Pattern 3

(01) check progress
(02) change strategy
(03) private speech

low_class_Pattern 3

(01) new goal pursuit
(02) change strategy
(03) private speech
(04) change strategy

high_class_Pattern 4

(01) change strategy
(02) private speech

low_class_Pattern 4

(01) new goal pursuit
(02) routine strategy
(03) private speech
(04) routine strategy

high_class_Pattern 5

(01) private speech
(02) change strategy

low_class_Pattern 5

(01) new goal pursuit
(02) routine strategy
(03) private speech
(04) routine strategy

Figure 7.1 Five speech patterns extracted from the *high* and *low group* in the **classroom** setting, arranged in descending order of duration across the dataset. The event type 'private speech' appears in red when it is followed by other events in a t-pattern, and in blue when it occurs at the end of a t-pattern.

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Laboratory

The top five private speech patterns extracted from the laboratory data, in descending order of duration across the dataset, for the *high* and the *low group* are shown in **Fig. 7.2**. The private speech utterances and unique behaviours are colour-coded as was done in **Fig. 7.1** previously.. As within the classroom setting, the *high group* demonstrated the unique presence of goal-directed monitoring behaviour (***check progress***) in all the patterns in **Fig. 7.2**. Meanwhile, in the *low group*, goal-relevant events (***goal attained*** and ***failed strategy***), not directly pertaining to achieving the goal-directed episode were found to be uniquely present within **low_lab_pattern 1 & 2** and **low_lab_pattern 3 & 4** respectively. It may be noted that in the 'tidy-up' task in the laboratory, the goal-relevant event ***goal attained*** was not an indication of successful completion of the goal of filling or closing a box, but actually an indication of stopping further efforts and considering the goal had been attained, despite not having followed all the rules. Children who managed to follow more rules of a task component usually exhibited the behaviour of ***goal attained*** less frequently, since they did not stop further efforts at solving the task, but attempted to follow more rules necessary for completing the task successfully. Hence its presence in a t-pattern indicates the frequent behaviour of stopping one's effort at attempting a task component, and moving on to another task component.
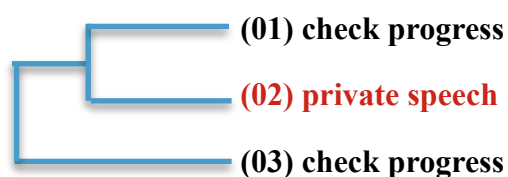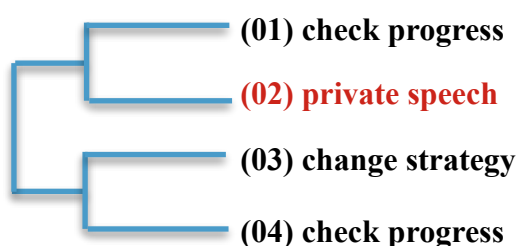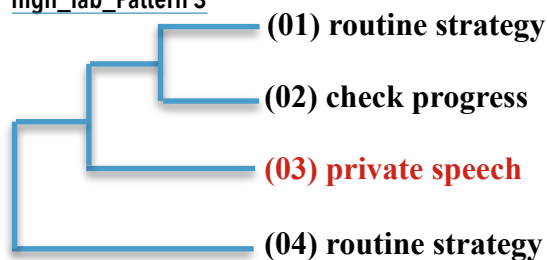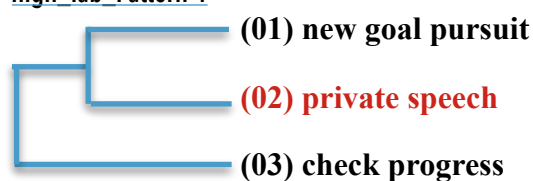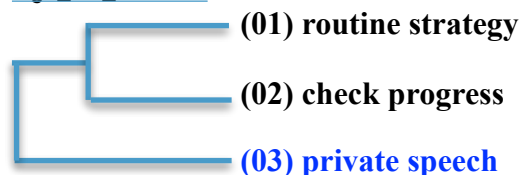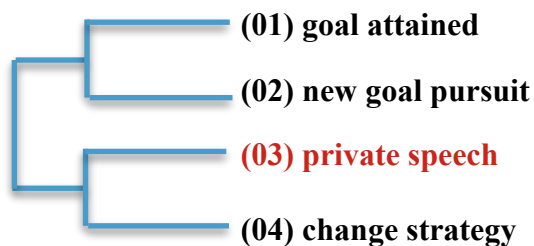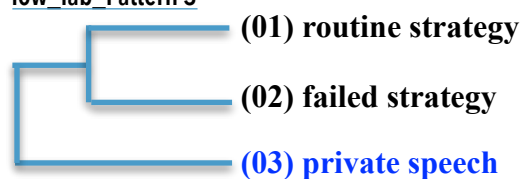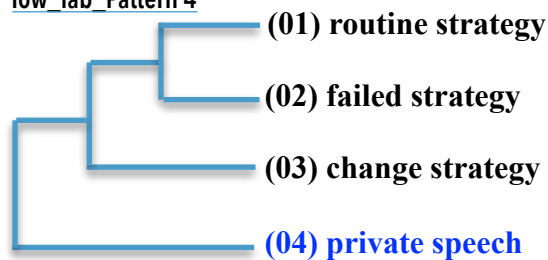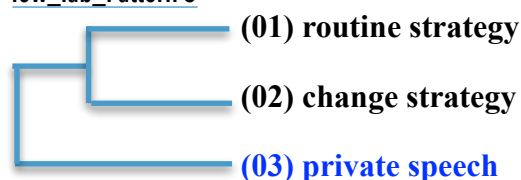
Figure 7.2 Five speech patterns extracted from the *high* and *low group* in the **laboratory** setting, arranged in descending order of duration across the dataset. The event type 'private speech' appears in red when it occurs in the middle of a t-pattern, and in blue when it occurs at the end of a t-pattern.

Conclusion

Hence, to conclude, private speech patterns extracted from the *high group* comprised goal-directed monitoring behaviours (***notice issue/error*** and ***check progress***), which were absent in the *low group* in both the classroom and the laboratory datasets. Whereas, behaviours specific to the private speech patterns extracted from the *low group* in both the settings, involved behaviours and events which were not directly involved in attaining the goal (e.g., ***new goal pursuit, failed strategy*** and ***goal attained)***. In fact, one of the behaviours, namely ***goal attained,*** was indicative of quitting behaviour in the laboratory-based task.

7.4.3.2 Temporal relation between unique behaviours and private speech

The other qualitative attribute to be compared was the temporal relation between the behaviours unique to each group and the private speech utterance immediately preceding or following it.

Classroom

For the classroom dataset, in the *high group,* only **high_class_pattern 2** comprised the unique goal-directed monitoring behaviour ***notice issue/error*** immediately followed by a private speech utterance. In the *low group* as well, only **low_class_pattern 2** consisted of the unique goal-mapping behaviour ***new goal pursuit*** immediately followed by a private speech utterance. Hence, based on their respective temporal relation in the pattern, private speech in both the groups appears to perform a role of verbal commentary, for behaviours unique to their group. However, the actual function of the private speech utterance can only be determined more accurately when an actual occurrence of the t-pattern is examined in real time, within a child's behavioural episode. Such a contextual analysis is presented in **Section 7.4.4.1**, for **high_class_pattern 2** from the *high group* and in **Section 7.4.4.2** for **low_class_pattern 2** from the *low group,* for the classroom dataset.

Laboratory

For the laboratory dataset, in the *high group,* the unique goal-directed monitoring behaviour ***check progress*** is immediately followed by a private speech utterance in **high_lab_pattern 1, 2, 3** and **5,** while it is preceded by a private speech utterance in **high_lab_pattern 4**. Hence, it may be argued that private speech may be reporting the results of the monitoring behaviour of ***check progress***, and hence playing the function of verbal commentary in the former case. Meanwhile in the latter case, the private speech utterance may be verbally guiding the monitoring behaviour. These claims can

only be substantiated by a contextual analysis of the events occurring in the t-patterns. In the *low group*, only **low_lab_pattern 3** consisted of the unique goal-relevant event ***failed strategy*** immediately followed by a private speech utterance. Hence, in this case private speech appeared to perform the role of verbal commentary or evaluation after the occurrence of the event of ***failed strategy***. To confirm these purported functions, contextual analysis of **high_lab_pattern 2** and **high_lab_pattern 4** from the *high group* and **low_lab_pattern 3** from the *low group,* is reported in **Section 7.4.4.1** and **Section 7.4.4.2** respectively, for the laboratory dataset.

Conclusion

Hence, to conclude, in the *high group,* monitoring behaviour ***notice issue/error*** was immediately followed by a private speech utterance in the classroom, while the monitoring behaviour ***check progress*** was both followed and preceded by a private speech utterance in different patterns in the laboratory dataset. Thus, children in the *high group* might be using private speech, both for *verbal commentary* or evaluation after monitoring the progress towards a goal, as well as for *verbal control* leading to monitoring behaviour. Both the scenarios were examined in the next section (see **Section 7.4.4.1)**, where contextual analysis of the particular t-patterns exhibiting such temporal relations was carried out. In the *low group,* in both the settings, behaviours and events mapping the course of a goal-directed episode were followed by a private speech utterance in their respective t-patterns. In the classroom dataset, ***new goal pursuit*** was followed by a private speech utterance, while in the laboratory dataset, ***failed strategy*** was followed by a private speech utterance. Thus, for the *low group,* private speech seemed to be fulfilling the function of *verbal commentary* in relation to the behaviours unique to the group. T-patterns from the *low group* containing these behaviours were contextually analysed in the subsequent section (see **Section 7.4.4.2)**.

7.4.4 Contextual analysis of private speech patterns

The final step in the comparative analysis of the private speech patterns extracted from each group, was the comparison of the styles of verbal mediation of behaviour, based on the real time contextual analysis of an actual occurrence of the selected t-patterns from each group, for the two settings. The contextual analysis of the t-patterns carried out here was similar to the one carried out in the previous chapter, wherein a specific instance of the occurrence of a t-pattern in the classroom or the laboratory dataset was then analysed in detail, laying out the 'description of the context', 'transcript of events' and finally the 'analysis of events'.

Such an analysis was able to highlight the presence of *verbal control* and *verbal commentary*, as the types of verbal mediation of behaviour employed by the children in the *high* and the *low group*. The previous step compared some of the qualitative attributes of the five selected private speech patterns belonging to each group. As a result of this comparison, one or two illustrative t-patterns from each group, from both, the classroom and the laboratory dataset, were selected for further contextual analysis. These t-patterns contained behaviours which were unique to the group to which they belonged and were immediately followed or preceded by a private speech utterance. The behaviour which was unique to the group in each pattern will henceforth be referred to as the 'target behaviour' and is highlighted in green in each of the patterns illustrated below. The private speech utterance which is temporally adjacent to the target behaviour is highlighted in red if it occurs before the target behaviour (possibly indicating *verbal control*), or in blue if it occurs after the target behaviour (possibly indicating *verbal commentary*). The analysis of the target behaviours along with the co-occurring private speech utterances in each pattern, within the context of a goal-directed episode, revealed styles of verbal mediation which were unique to that group.

7.4.4.1 High Group

Within the *high group*, one pattern was selected from the classroom dataset (**high_class_pattern 2**), while two of them were selected from the laboratory dataset (**high_lab_pattern 2** & **high_lab_pattern 4**) for contextual analysis. In **high_class_pattern 2** and **high_lab_pattern 2**, the target behaviour was followed by the private speech utterance (highlighted in blue). However in **high_lab_pattern 4**, the target behaviour was preceded by the private speech utterance (highlighted in red).

Classroom

high_class_pattern 2

Figure 7.3 High_class_pattern 2 selected from the five private speech t-patterns belonging to the *high group* in the classroom dataset (see Figure 7.2), with target behaviour (unique to the *high group*) in green and the private speech utterance following it, shown in blue : no. of occurrences = 35; duration = 3% of dataset; pattern length = 3; pattern level = 2

The t-pattern (**high_class_pattern 2)** illustrated in **Fig. 7.3** was selected from the five private speech patterns belonging to the *high group,* from the classroom dataset. The t-pattern had occurred 35 times in the dataset, and was the second longest in duration across the dataset, with a duration spanning 3% of the classroom dataset for the *high group*. It comprised two internal intervals spanning across the three events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = 0s; **Max I1** (longest time interval between events 1 and 2 in all pattern occurrences) = 8.96s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = .04s; **Max I2** (longest time interval between events 2 and 3 in all pattern occurrences) = 30.80s.

One instance of its occurrence during a goal-directed episode in the classroom involving Child 4 from the *high group* is described below. Similar to the contextual analysis of the t-patterns carried out in the previous chapter, the general context in which the events of this t-pattern is embedded will be described first. This will be followed by a timed and coded transcript of the events, not all of which were picked up in the t-pattern search. The events in the transcript which were part of the t-pattern are illustrated in bold. An analysis of the events is then carried out to understand the probable functional relationship between the speech and behaviours that occur in the t-pattern in the given context.

Description of the context:

The above t-pattern was extracted from a 'tidying up' session at the end of the playtime in the classroom, where Child 4, along with two other children, was jointly involved in putting all the Duplo bricks lying on the floor, back in a tray. At this point, most of the bricks had been picked up from the floor and Child 4 along with the two children were collecting the remaining bricks to put in the tray. The transcript of events reported below begins with Child 4, seated on the floor, and performing a routine strategy to achieve her goal, by collecting the bricks from the floor with both her hands. As she turned to place the pieces in the tray, she noticed a green-coloured brick, which had been left on the floor. **Fig. 7.4** is a snapshot of this moment when Child 4 noticed the brick, while putting the bricks in her hands, back in the tray. She then uttered a private speech in the form of an exclamation. After this, she changed her previous strategy of collecting several pieces together, and instead picked up the single brick from the floor, which had been left behind. The three events present in the t-pattern are highlighted in bold in the transcript of events given below.

Figure 7.4 Snapshot of the moment when Child 4 (girl in pink dress) noticed an error, the green-coloured brick left behind on the floor.

Transcript of events:

(1) 227.16s: [Child 4] Pick up some of the bricks from the floor with both hands, to put in the tray **<routine strategy>**

(2) **227.88s: [Child 4] Notice the green-coloured brick left on the floor <notice issue/ error >**

(3) **228.28s: [Child 4] "Aahh" <private speech, task-relevant, emotive: expressive >**

(4) **2**28.78s: **[Child 4] Pick up the single brick from the floor <change strategy >**

Analysis of events:

After noticing the brick which had not been picked up from the floor, in line (2) of the transcript, Child 4 uttered a private speech in line (3). The speech was classified as private because Child 4 produced this utterance without making any social behavioural gestures such as body posture or a direct eye-contact with the other children. There was no social speech immediately preceding this utterance. However, it was not lower in volume, and could be clearly heard by others around Child 4. The speech was labeled as task-relevant, since it was produced immediately after having noticed an error while monitoring one's progress towards the shared goal of picking up all the Duplo bricks. The utterance was in the form of an exclamation ("*Aahh"*) and expressed the child's surprise at noticing an error, which needed to be corrected. Hence it was coded as *expressive,* and placed under the pragmatic category of *emotive speech.* The utterance verbally expressed Child 4's emotion of

surprise after having noticed the error that had been committed by leaving that brick on the floor. Child 4 then proceeded to correct the error regarding which she had exclaimed in the previous speech utterance, by changing her previous strategy in line (4) and picking up that single brick to put it into the tray. Therefore, the private speech utterance seemed to comment upon the error and make it salient through her speech, so that she could subsequently act upon it and correct it. This could be meant both for herself directly, and perhaps also for the other children nearby, informing them indirectly to be on the lookout for such errors themselves. Hence the above analysis of the context and temporal order of the *emotive* speech preceded by the goal-directed monitoring behaviour of *notice issue/error* and followed by the error correction in the form of *change strategy* indicated both *verbal commentary* for the mediatory relationship between *notice error/issue* followed by *emotive speech* and *verbal control* for the mediatory relationship between *emotive speech* followed by *change strategy*. The pattern also highlighted an adaptive sequence of behaviours involving monitoring of one's task, reporting any errors observed during the monitoring, and then acting upon the report to correct the observed error.

Laboratory:

Two t-patterns were selected from the set of five patterns belonging to the laboratory dataset, since the temporal order of the private speech utterance with respect to the same target behaviour (***check progress***) was different in the two patterns. While in **high_lab_pattern 2**, target behaviour was followed by a private speech utterance, the order was reversed in **high_lab_pattern 4.** Hence both the patterns were selected for further contextual analysis.

high_lab_pattern 2

(01) check progress

(02) private speech

(03) change strategy

(04) check progress
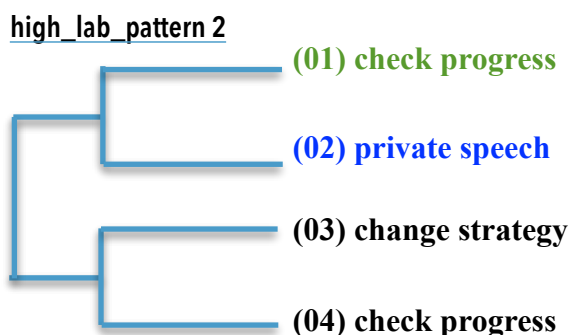
Figure 7.5 High_lab_pattern 2 selected from the five private speech t-patterns belonging to the *high group* in the laboratory dataset (see Figure 7.2), with target behaviour (unique to the *high group*) in green and the private speech utterance following it, shown in blue : no. of occurrences = 17; duration = 8% of dataset; pattern length = 4; pattern level = 2

The t-pattern (**high_lab_pattern 2)** illustrated in **Fig. 7.5** was selected from the five private speech patterns belonging to the *high group,* from the laboratory dataset. It occurred 17 times in the dataset, and was the second longest in duration across the dataset, with a duration spanning 8% of the laboratory dataset for the *high group*. It comprised three internal intervals spanning across the four events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = .05s; **Max I1** (longest time interval between events 1 and 2 in all pattern occurrences) = 4.83s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = .5s; **Max I2** (longest time interval between events 2 and 3 in all pattern occurrences) = 8.54s.; **Min I3** (shortest time interval between events 3 and 4 in all pattern occurrences) = .83s; **Max I3** (longest time interval between events 3 and 4 in all pattern occurrences) = 8.58s. One instance of its occurrence during a goal-directed episode in the laboratory involving Child 6 from the *high group* is described below.

Description of the context:

The above t-pattern was extracted from a goal-directed episode in the 'tidy-up' task carried out in the laboratory. Child 6 was solving the task alone, by filling the three boxes of varying sizes with the appropriate coloured Duplo pieces. At this point, Child 6 had started filling the smallest box with yellow-coloured Duplo pieces. It may be noted that the appropriate colour for the smallest box was blue, as some of the yellow pieces were too big to fit inside the smallest box. However Child 6 continued to place the large yellow pieces in the box, even as they protruded out of the box. While picking up more yellow pieces from the carpet, a red-coloured Duplo brick came into her hands. She examined the box to see if the red brick would fit in. The transcript of events reported below begins when Child 6 continued to place the red brick into the smallest box with the other yellow pieces. After doing so, she examined the box and the red brick in it. She then produced a private speech utterance - "*too much*", referring either to the red brick or the condition of the box with the addition of the last piece. She then removed the red brick from the box. **Fig. 7.6** is a snapshot of this moment when Child 6 removed the brick from the box. She produced a transitional utterance ("*uh*") while removing the brick, after which she examined the box again. The four events present in the t-pattern are highlighted in bold in the transcript of events given below. Since Child 6 was alone in the laboratory during this episode, all speech utterances were classified as private.

Figure 7.6 Snapshot of the moment when Child 6 removed the red brick from the box with yellow pieces

Transcript of events:

(1) 177.87s: [Child 6] Place the red brick in the smallest box with other yellow piece **\<change strategy>**

(2) 178.88s: [Child 6] Examine the box and the red brick in it \<check progress >

(3) 178.92s: [Child 6] "Too much" \<private speech, task-relevant, evaluative: evaluative>

(4) 181.41s: [Child 6] Remove the red brick from the box \<change strategy >

(5) 181.45s: [Child 6] "uh" **\<private speech, task-relevant, other: transitional>**

(6) 182.91s: [Child 6] Examine the box again \<check progress >

Analysis of events:

After checking for the appropriateness of placing the red brick in the smallest box, in line (2) of the transcript, Child 6 uttered a private speech - "*too much*", in line (3). The speech was labeled as task-relevant since it referred to the task at hand. The utterance provided an assessment of the condition of the box as being overfilled after the addition of the red brick. Hence it was coded as *evaluative,* and placed under the pragmatic category of *evaluative speech.* The utterance verbally reported the result of the previous monitoring behaviour (*check progress*), when the box was examined in line (2). Child 6 then proceeded to change the condition of the box (*change strategy*), which she had reported about in the previous speech utterance, by removing the red brick from the box, in line (4). The transitional private speech (in line (5)) seemed to simply accompany her

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removing action, and was not picked up in the t-pattern. After removing the red brick, Child 6 again examined the box to probably ascertain that her previous assessment of the box's condition with the red brick and its condition after removing the brick were appropriate. Therefore, the private speech utterance seemed to comment upon the error and make it salient through her speech, so that she could subsequently act upon it and correct it. Hence the above analysis of the context and temporal order of the goal-directed monitoring behaviour of *check progress* followed by *evaluative speech* indicated *verbal commentary* as the mediatory relation between the speech utterance and the monitoring behaviour.   The private speech utterance was followed by the goal-directed error correction in the form of *change strategy* indicating *verbal control* as the mediatory relationship between *evaluative speech* followed by *change strategy*. Hence, the sequence of events in the t-pattern demonstrate verbally mediated error correction after monitoring the task for any errors. The various temporal relationships between the events in the **high_lab_pattern 2** so far appear to be similar to the relationships demonstrated by the **high_class_pattern 2** analysed previously from the classroom dataset for the *high group.* This t-pattern also comprised an additional monitoring behaviour (*check progress*), after *change strategy,* thereby indicating further assessment of the situation after error correction.

high_lab_pattern 4

(01) new goal pursuit

(02) private speech

(03) check progress

Figure 7.7 High_lab_pattern 4 selected from the five private speech t-patterns belonging to the *high group* in the laboratory dataset (see Figure 7.2), with the private speech utterance shown in red and the target behaviour (unique to the *high group*) following it, in green: no. of occurrences = 10; duration = 5% of dataset; pattern length = 3; pattern level = 2

The t-pattern (**high_lab_pattern 4)** illustrated in **Fig. 7.7** was another of the t-patterns selected from the five private speech patterns belonging to the *high group,* from the laboratory dataset. It occurred 10 times in the dataset, and was the fourth longest in duration across the dataset, with a duration spanning 5% of the laboratory dataset for the *high group*. It comprised two internal intervals spanning across the three events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = .01s; **Max I1** (longest time interval between events 1 and 2 in all pattern

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occurrences) = 2.46s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = 1.06s; **Max I2** (longest time interval between events 2 and 3 in all pattern occurrences) = 16.24s. One instance of its occurrence during a goal-directed episode in the laboratory involving Child 4 from the *high group* is described below.

Description of the context:

The above t-pattern was extracted from the 'tidy-up' task carried out by Child 4, while alone in the laboratory. Child 4 had already filled all the three boxes with the appropriately coloured Duplo pieces in most cases. However, while trying to fix the lids on each of the boxes, she took out some of the pieces which were protruding out, from all the boxes. Hence these few additional pieces were lying on the carpet where the task was being carried out, while the largest box with the red pieces inside it was closed with its lid on top. At this point in the task, Child 4 had just closed the largest box, when she noticed a large red piece lying outside on the carpet. The transcript of events reported below begins when Child 4 started a *new goal pursuit* of placing the pieces remaining outside on the carpet into the boxes. In order to attain the goal, she picked up the red piece from the carpet, as a *routine strategy*. With the piece still in her hands, she then produced a private speech utterance in the form of a question - "[..] *what's that goes?*". She then examined the piece in her hands. **Fig. 7.8** is a snapshot of this moment of *check progress* when Child 4 looked down and examined the red piece in her hands. The three events present in the t-pattern are highlighted in bold in the transcript of events given below. Since Child 4 was alone in the laboratory during this episode, all speech utterances were classified as private.

Figure 7.8 Snapshot of the moment when Child 4 *checked progress* by examining the red piece in her hands.

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Transcript of events:

(1) **554.96s: [Child 4] Goal: Place the pieces left outside into the boxes** <new goal pursuit>

(2) 555.08s: [Child 4] Pick up the red piece, noticed earlier,from the carpet<routine strategy >

(3) **555.61s: [Child 4] "[…] What's that goes?"** <private speech, task-relevant, seek/respond: seek information>

(4) **557.68s**: **[Child 4] Examine the red piece again** <check progress >

Analysis of events:

With the *new goal pursuit* (in line (1)) of placing all the pieces remaining outside on the carpet, into the three boxes which had been filled already, Child 4 carried out a *routine strategy* (in line (2)), of picking up a red piece from the carpet, which she had noticed slightly earlier in the episode (not shown in the transcript). However, as all the boxes were already full, with the lid placed on the largest box in front of her, finding an empty space in the boxes presented a challenge to Child 4 in attaining her intended goal. After this, Child 4 uttered a private speech (with the unclear initial part represented as "[…]") - "*[...] what's that goes?"*, in line (3). The speech was labeled as task-relevant since the word "that" in the utterance referred to the red piece held in her hands. The utterance was spoken in the intonation of a question, and appeared to seek information about the appropriate place to put the red piece, albeit from the speaker herself. Hence it was coded as *seek information,* and placed under the pragmatic category of *seek/respond.* Hence, the utterance verbalised the problem being faced by Child 4 at that moment. Next, through the monitoring behaviour (*check progress*) carried out by Child 4 in line (4), she seemed to assess the problem that was verbalised previously, by examining the size and shape of the piece in her hands, before looking for an appropriate place for it in one of the boxes. Therefore, the question posed to oneself through the private speech utterance (*seek information*) seemed to provide *verbal control,* as it lead to examining one's situation through the monitoring behaviour of *check progress*. Hence, the sequence of events in the t-pattern demonstrate verbally mediated monitoring of the task, to look for solutions, after facing an obstacle. The temporal relationship between the events in the **high_lab_pattern 4** hence demonstrate another type of verbal mediation (verbal initiation of monitoring behaviour), which was different from the type of verbal mediation indicated by the last two patterns (**high_class_pattern 2 & high_lab_pattern 2)** in the *high group* (verbal initiation of error correction as a consequence of previous monitoring behaviour). However both represent elaborate forms of self-regulation involving monitoring for errors or obstacles in the task and

correcting the observed errors or solving the obstacles highlighted earlier.

7.4.4.2 Low group

Within the low group, one pattern was selected from the classroom dataset (low_class_pattern 2), and one pattern was selected from the laboratory dataset (low_lab_pattern 3) for contextual analysis. In both the patterns, the target behaviour was followed by the private speech utterance (highlighted in blue).

Classroom

low_class_pattern 2

(01) new goal pursuit

(02) private speech

(03) routine strategy
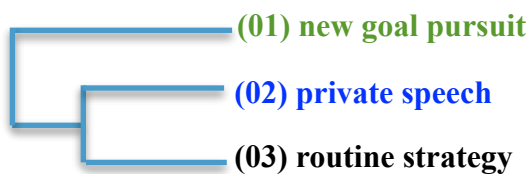
Figure 7.9 Low_class_pattern 2 selected from the five private speech t-patterns belonging to the *low group* in the classroom dataset (see Figure 7.1), with the target behaviour (unique to the *high group*) in green and the private speech utterance following it, shown in blue : no. of occurrences = 21; duration = 4% of dataset; pattern length = 3; pattern level = 2

The t-pattern (**low_class_pattern 2)** illustrated in **Fig. 7.9** was selected from the five private speech patterns belonging to the *low group,* from the classroom dataset. It occurred 21 times in the dataset, and was the second longest in duration across the dataset, with a duration spanning 4% of the laboratory dataset for the *high group*. It comprised two internal intervals spanning across the three events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = 0s; **Max I1** (longest time interval between events 1 and 2 in all pattern occurrences) = 23.808s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = .24s; **Max I2** (longest time interval between events 2 and 3 in all pattern occurrences) = 8.78s. One instance of its occurrence during a goal-directed episode in the classroom involving Child 5 from the *low group* is described below.

Description of the context:

The above t-pattern was extracted from a goal-directed episode involving Child 5 and another child, playing at the sand pit inside the classroom. The two children had been involved in a pretend play scenario where the sand pit was a pirate ship and a tin box was a treasure chest filled with sand and

some trinkets filled up by the two children, earlier in the play. At this point in the game, the two children had just placed the 'treasure chest' (tin box) on the 'pirate ship' (sand pit). Child 5 wanted to start another round of pretend play involving filling the 'treasure chest' with sand and 'treasure' dug out from the sand in the sand pit. Hence he wanted to empty the tin box by pouring out all its contents into the sand pit, so that he could start filling the box again. The transcript of events reported below begins with the *new goal pursuit* that Child 5 had initiated, of acting out the pretend play script of filling the 'treasure chest' again. He then produced a private speech utterance- "*Oh I'm pouring the*", which was left incomplete midway. After this he started pouring out the sand from the box, as a *routine strategy* for emptying the box, in order to pursue his goal of filling it again with 'treasure'. **Fig. 7.10** is a snapshot of this moment when Child 5 started tilting the box to pour out the sand. All the three events present in the transcript of events are in the t-pattern.

Figure 7.10 Snapshot of the moment when Child 5 (boy in red sweater) started emptying the tin box by tilting it.

Transcript of events:

(1) 260.96s: [Child 5] Goal: Filling the 'treasure chest' <new goal pursuit>

(2) 261.05s: [Child 5] "Oh, I'm pouring the" <private speech, task-relevant, directive: proposing a plan>

(3) 262.42s: [Child 5] Tilt the box to pour out the sand <routine strategy>

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Analysis of events:

With the *new goal pursuit* (in line (1)) of intending to enact the scenario of filling up the 'treasure chest' again with the 'treasure', Child 5 carried out a *routine strategy* (in line (3)), of emptying the box which was already filled with sand, so that it could be filled again. However Child 5 had so far been playing at the sand pit with another child. Hence, the new goal and the actions required to attain the goal had to be conveyed to the other child, prior to initiating them. Hence in line (2), before beginning to empty the box, Child 5 seemed to announce his plan to do so in a private speech utterance "*Oh, I'm pouring the…*". The speech was labeled as private, since it was produced with a muffled pronunciation in a lowered volume, without making any eye-contact with the other child or accompanying the speech with any behavioural gesture that may suggest the speech to be social. However it was considered to be task-relevant as it contained the word "*pouring",* and the utterance was immediately followed by the action undertaken by Child 5 to pour out the sand from the box. Although the utterance was spoken in the present continuous tense ("*..I'm pouring…*"), as if Child 5 was describing his ongoing action, it was considered to be a future-oriented statement because he had not started pouring out the sand from the box when he produced the utterance. Hence it was coded as *proposing a plan,* and placed under the pragmatic category of *directive.* The utterance prefaced the action that Child 5 was about to perform, and indirectly informed the other child about Child 5's plans and the shared goal that he was being directed to follow. The temporal relationship between *new goal pursuit* and the private speech utterance, in this case, demonstrates verbal mediation in the form of *verbal commentary,* wherein routine actions involved in attaining an intended goal are reported in advance . Thus the scenario presented above did not present any moment of difficulty which required an active monitoring of the task or correcting an error. Hence, unlike the t-patterns extracted from the *high group* which represented elaborate forms of self-regulation involving monitoring or error correction, the sequence of events in this t-pattern from the *low group* demonstrate verbal mediation of conventional behaviour in a goal-directed episode.

Laboratory

low_lab_pattern 3

- **(01) routine strategy**
- **(02) failed strategy**
- **(03) private speech**
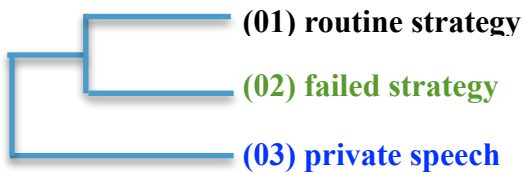
Figure 7.11 Low_lab_pattern 3 selected from the five private speech t-patterns belonging to the *low group* in the laboratory dataset (see Figure 7.2), with the target behaviour (unique to the *high group*) in green and the private speech utterance following it, shown in blue : no. of occurrences = 13; duration = 7% of dataset; pattern length = 3; pattern level = 2

The t-pattern (**low_lab_pattern 3**) illustrated in **Fig. 7.11** was selected from the five private speech patterns belonging to the *low group,* from the laboratory dataset. It occurred 21 times in the dataset, and was the second longest in duration across the dataset, with a duration spanning 4% of the laboratory dataset for the *high group*. It comprised two internal intervals spanning across the three events in the pattern. Pattern statistics describing the two internal intervals are as follows: **Min I1** (shortest time interval between events 1 and 2 in all pattern occurrences) = .16s; **Max I1** (longest time interval between events 1 and 2 in all pattern occurrences) = 4.22s; **Min I2** (shortest time interval between events 2 and 3 in all pattern occurrences) = .06s; **Max I2** (longest time interval between events 2 and 3 in all pattern occurrences) = 20.76s. One instance of its occurrence during a goal-directed episode in the laboratory involving Child 1 from the *low group* is described below.

Description of the context:

The above t-pattern was extracted from the 'tidy-up' task carried out jointly by Child 1 with Child 2 in a dyad. The children had filled the largest (box L) and the medium-sized (box M) boxes with Duplo pieces, and were now engaged in closing them by fastening the lids on top. Child 1 had been individually trying to close the the largest box (box L), but was unable to fit its lid in place, on top of the box. In the meanwhile, Child 2 was trying to close the medium-sized box (box M), when he pointed out a red-coloured piece lying on the carpet to Child 1, which was supposed to go into box L. At this point in the task, Child 1 had just placed the piece pointed out by Child 2, inside box L, rearranged the pieces slightly to make space for the new piece, and then proceeded to attain her goal of closing box L with its lid again. The transcript of events reported below begins when Child 1 started the *routine strategy* of placing the lid on top of box L again. She was unable to close the lid,

since some pieces were protruding out of the box. As a result, she had to encounter a *failed strategy*. While still sliding the lid on top of the box, she produced a private speech utterance in the form of an exclamation - "*Hohh! I can't do it*". Thereafter she just left the lid on box L and stopped any further efforts at fastening the lid tightly on top of the box. This was coded as a *goal attained* behaviour, since from the perspective of Child 1, her goal of closing the box had been achieved and no further efforts were required. She then proceeded towards a *new goal pursuit* of closing the lid of box M together with Child 2. **Fig. 7.12** is a snapshot of this moment when she had left her previous goal pursuit and moved on to the new goal. The three events present in the t-pattern are highlighted in bold in the transcript of events given below.

Figure 7.12 Snapshot of the moment when Child 1 (girl on the right) left her previous goal and started pursuing the shared goal with Child 2 of closing box M.

Transcript of events:

(1) **420.26s: [Child 1] Place the lid on top of box L <routine strategy>**

(2) **424.08s: [Child 1] Not able to fit the lid tightly as pieces protruding out from the box <failed strategy>**

(3) **424.22s: [Child 1] "Hohh! I can't do it" <private speech, task-relevant, evaluative: metacognitive self-knowledge>**

(4) 426.88s: [Child 1] Leaves the lid just placed but unfastened on box L, considers goal complete <goal attained>

(5) 428.45s: [Child 1] Goal: close box M together with Child 2, by fastening its lid on top <new goal pursuit>

Analysis of events:

With the goal of closing box L with its lid, Child 1 carried out a *routine strategy* of fastening the lid on top of the box, in line (1) of the transcript. However as the pieces in the box had not been closely packed, some of them were protruding out of the box. Hence, Child 1 could not fit the lid tightly on the box and encountered a *failed strategy* in line (2). Faced with such a challenge, an example of high degree of self-regulation would have involved monitoring the task progress in order to identify errors in the current strategy, and perhaps come up with a solution. Instead, Child 1 produced a private speech utterance - "*Hohh! I can't do it*", in line (3). The speech was labeled as private since it was produced without any eye-contact or any other behavioural gesture that may suggest the speech to be social. It was also recognised as task-relevant since it described Child 1's current state with regards to the task at hand. Through this utterance Child 1 made an evaluative statement about her inability in attaining her goal. Hence it was coded as *metacognitive self-knowledge,* and placed under the pragmatic category of *evaluative speech*. In behaviours subsequent to the speech utterance, Child 1 did not persist further in completing that task component fully (closing box L), and instead moved on to complete another task component (closing box M). An negative evaluation of one's ability when faced by a hindrance in the task might have contributed to the termination of further efforts in achieving the goal. This is in contrast to the instance of verbal initiation of monitoring behaviour after facing an obstacle, exemplified by **high_lab_pattern 4**, analysed earlier. Therefore, the temporal relationship between the events in the **low_lab_pattern 3** demonstrate a type of verbal mediation which was detrimental to persistence in face of adversity during a goal-directed behaviour, and instead instigated quitting behaviour.

7.5 Summary of Results

The participants in the study were divided into two groups on the basis of the frequency of speech patterns found in their goal-directed behaviour. Differences between the two groups were observed in their degree and style of verbal mediation of behaviour. The quantitative analysis examined whether children who frequently exhibited patterned behaviour with private speech and goal-related behaviour were also more self-regulated and performed better in the laboratory-based 'tidy-up' task. The qualitative analysis then went on to examine the patterns of speech and behaviour which were unique to the *high* or the *low group.* Contextual analysis of a selection of t-patterns revealed group differences in the style of verbal mediation of behaviour. The following sections highlight the main findings for this chapter.

7.5.1 Consistency across measures of patterned behaviour and performance

In the quantitative analysis, the consistency of group membership (*high* or *low group*) was examined between the frequency of all speech patterns (*frequency of speech patterns*) and the measure of unique speech patterns (*PattDiff_speech)*, the measure of self-regulation in the classroom (*SR score_class*), self-regulation in the laboratory-based 'tidy-up' task (*SR score_lab*), performance in the task (*task performance score*) and overall self-regulation and task performance in the laboratory (*total lab score*). The comparisons revealed considerable (though not absolute) consistency in group memberships when compared with the first measure. Hence the two groups of children divided initially on the basis of the frequency of patterned behaviour involving speech and goal-directed behaviour also represented two levels of self-regulatory behaviour and task performance. If the two speech-related measures mentioned above could be understood to represent degree of verbal mediation of behaviour, as expressed in the recurring speech and behaviour patterns, then it may be said that most children who exhibited a higher degree of verbal mediation of behaviour also showed a higher degree of successful self-regulation in the classroom and overall goal-directed behaviour in the laboratory-based task. While these results are based on a very small group of children and hence cannot be used for making claims about normative behaviour in preschool children, it may be worthwhile to employ such a method of analysis that examines consistency across a variety of speech and behavioural measures, when investigating individual differences in verbal mediation of behaviour.

7.5.2 Verbal mediation of behaviour not related to talkativeness

The comparison of group membership between frequency and variety of speech patterns (*frequency of speech patterns* and *PattDiff_speech*) and measure of *talkativeness* revealed that the two were almost inversely related. This indicated that children who spoke more frequently did not necessarily exhibit a higher degree of verbal mediation of behaviour. Thus the specific timing of task-relevant speech in relation to goal-related behaviours was more relevant than the sheer frequency of speech utterances in determining the prevalence of speech and behaviour patterns. Hence it may be wrong to assume that children who speak more would necessarily be employing verbal mediation of behaviour as a strategy in solving tasks or during general goal-directed behaviour.

7.5.3 Development of self-regulation score

In most private speech studies, task difficulty or final task performance have been used as proxy measures of self-regulation, since it is assumed that a difficult task or good performance in a task would have necessarily involved self-regulation. However, these measures do not examine the actual moments of difficulty faced by a child in solving a task, and how these obstacles are successfully overcome through the deployment of self-regulatory strategies. Neither are failures of self-regulation measured in such assessments. The self-regulation scores developed in this study examined actual instances of different types of successful and failures of self-regulation, through examining characteristic sequences of behaviour that occurred naturally in the goal-directed episodes, in the classroom (SR score_class) as well as in the laboratory-based task (SR score_lab). The final scores were calculated as a success to failure ratio. In this study, consistent group membership was seen between the SR score_class and the SR score_lab. Hence both the scores seemed to be measuring a core individual aptitude of self-regulation, expressed equally in the classroom and in the laboratory.

It may be noted that on many occasions, the same behaviour featured in a sequence of behaviours identified as successful self-regulation as well as in a sequence of behaviours identified as a failure of self-regulation. The context in which the particular behaviour occurred with other behaviours determined its classification as a success or a failure of self-regulation. Hence, when assessing self-regulation through direct observation, it may be important to consider the effect of the broader context in interpreting any single behaviour as an instance of adaptive or maladaptive behaviour in relation to goal attainment.

7.5.4 Observing behaviour in a naturalistic laboratory-based task

The naturalistic goal-directed episodes observed in the classroom were governed by goals that were child-initiated and therefore, were meaningful to the children involved. However these goals were mostly open-ended in nature. Therefore, behaviour exhibited in these goal-directed episodes could not be assessed against any standard or expected performance. Hence, one of the aims of the study was to observe goal-directed behaviour within the controlled environment of an observational laboratory, wherein the goal was closed-ended and predetermined. However, it was also important to maintain the naturalistic and meaningful nature of goals in the laboratory-based task, as was the case in the classroom, in order to obtain comparable data. Hence, the 'tidy-up' task developed in this study was designed in such a way as to seem like a natural activity to the children, which they were accustomed to doing in the classroom everyday at the end of a play session. It was also placed between two activities with a background narrative that provided meaning to the task, instead of coming across as a meaningless exercise to the children. In this way, the naturalistic quality of the task was maintained.

The final goal of the task was fixed and involved filling the three differently sized boxes with appropriately-coloured pieces and closing them with their respective lids. Such a task was purposefully designed to be slightly beyond the normal ability of the children in the study, in order to present a suitable challenge to them. However it could be easily divided into six components (fill_box(L, M & S) and close_box(L, M & S)), and hence performance on each of the components could be assessed separately. A binary assessment of the entire task as pass or fail would have underestimated the effort put in by the children in completing different components of the task, even if failing to achieve the final goal. Thus, instead of assigning a final score of pass or fail, the task was assessed as a composite of scores obtained on each of the six components of the task. This enabled a more continuous assessment of performance in the task, which covered a wide range of abilities exhibited by the children in solving the task.

Another important feature of the naturally occurring goal-directed episodes in the classroom was the temporally extended nature of the intended goals. The goals set by the children required concerted effort in maintaining goal-directed activity over long periods of time, without getting distracted or forgetting the goal itself. The meaningful nature of the goals and the personal motivation to achieve them would have driven the children to maintain continuous effort towards achieving such extended goals. Laboratory-based tasks, which are suitable for children, usually test

for several executive functions such as attention, working memory, impulse control, etc. However, in order to maintain the interest of the children in the task, they are usually designed as a series of short and repetitive multiple trials. Thus, they are not able to capture the extended effort required in actively maintaining and pursuing goals over a longer timeframe. The 'tidy-up' task was able to incorporate this feature into its design, as the children were fully engaged in the task for a period extending several minutes. Moreover, due to the natural division of the task into the six components, the task was not repetitive, and managed to stimulate the children with different types of challenges over a long period of time.

7.5.5 Differences in verbal mediation of goal-directed behaviour

Contextual analysis of private speech patterns unique to the *high* and the *low group* revealed qualitative differences in the way children in each group exhibited verbally mediated self-regulation during the goal-directed episodes in the classroom and the laboratory.

Within each private speech pattern, the temporal relationship between the private speech utterance and the goal-related behaviour (which was unique to each group), was examined to reveal the presence of verbal mediation of behaviour, either in the form of *verbal commentary* (if behaviour was followed by speech) or as *verbal control* (if speech was followed by behaviour). In the *low group,* the temporal relationship revealed *verbal commentary* as the main role of private speech with respect to behaviour. In **low_class_pattern 2**, private speech simply reported the routine goal-directed strategy in advance, while in **low_lab_pattern 3**, a negative evaluation of one's ability was expressed in the private speech after facing a failure, which was followed by quitting the goal pursuit. Hence in both cases, a low level of verbally mediated self-regulation was evident. In the *high group,* both *verbal commentary* and *verbal control* was evident as the roles played by private speech with respect to behaviour. In **high_lab_pattern 4**, private speech verbalised the problem encountered earlier and initiated subsequent monitoring behaviour, which searched for a solution to the problem. Hence in this case, private speech carried out *verbal control* with respect to the subsequent monitoring behaviour. In both **high_class_pattern 2** and **high_lab_pattern 2**, the private speech verbally initiated error correction after reporting the results of previous monitoring of the ongoing task. Hence, private speech carried out *verbal commentary* with respect to the previous monitoring behaviour and *verbal control* with respect to the subsequent error correction. In all three cases, a high level of verbally mediated self-regulation was evident from the monitoring and error correction behaviours that the patterns expressed.

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Hence the *high* and the *low group* could also be distinguished on the basis of qualitative differences between their levels of self-regulation, apart from the quantitative difference between them, illustrated by their self-regulation and task performance scores in the classroom and the laboratory.

Chapter 8. Discussion

8.1 Introduction

This chapter begins with a discussion on the technical and methodological limitations of this study, as well as those issues which could not covered by the present study due to its limited scope as a doctoral project, while making recommendations for future research. This is followed by a summary of the main research findings from the current study, in response to each of the research questions and discussed in light of previous research. Finally, the significant theoretical, methodological and educational contributions of this study are discussed, followed by a conclusion of the study and closing thoughts.

8.2 Limitations and future recommendations

Those issues or phenomena, which the theoretical and methodological approach of this study was not able to investigate, are discussed below. Future recommendations, if any, on such issues have also been made.

8.2.1 Exploratory nature of the study: testing a new methodology

This study systematically observed the goal-related behaviours and spontaneous speech of eight children across two preschools, in their classroom setting as well as in a laboratory-based task. Due to the small number of participants, the findings of the study cannot be generalised. The study, whose nature was primarily exploratory, devised a novel method to investigate the phenomena of verbal mediation of behaviour in real-time. The use of t-pattern analysis coupled with a detailed contextual analysis of the recurring speech and behaviour events within t-patterns, demonstrated a rigorous methodology which was temporally and contextually sensitive to the phenomena under investigation, and hence moved beyond static correlational methods.

Future research should employ this methodology in a scaled-up study, with a larger sample size. This would ensure a larger dataset for the t-pattern analysis, and hence, a balanced representation of all types of behaviours within the dataset. This would be able to avoid Type I and Type II detection errors, which were observed in the t-pattern searches in this study, wherein some ubiquitous behaviours in a goal-oriented episode were over-represented in a t-pattern, while others were not detected in a t-pattern due to their rare occurrence in the episode.

8.2.2 Regulation of emotions and motivation not investigated

The nature of goals driving the goal-oriented episodes recorded in this study, were not restricted to the cognitive domain only. Since these goals were assessed from the perspective of the observed preschool child, they inevitably comprised social, emotional and motivational goals such as-inclusion in a game, avoiding emotional outburst in a challenging or confrontational situation, and continuing a task despite failures or difficulties. However, the focus of the study was on regulation in the cognitive domain, although aspects of social, emotional and motivation regulation cannot be ignored, if one has to investigate the full range of regulatory behaviour that young children spontaneously engage in. The limited scope of this doctoral project did not allow a systematic investigation of these domains. Particularly, while examining emotional self-regulation, it is difficult to make a clear distinction between the expression of emotions and regulation of emotions, simply based on the observation of behaviour. If an emotion is expressed but is also purported to be regulated, then an implicit assumption is being made that the expressed emotion is more controlled than it would have been, in its unregulated form and intensity. However the canonical expression of an emotion which could have been expressed in a particular situation can only be hypothesised. Moreover, the absence of an expected emotion may or may not count as an instance of the regulation of that emotion. Researchers have hence advocated the use of physiological measures such as traces of emotion through skin resistance, EEG, etc., along with behavioural observations and self-report (Stifter, Spinrad & Braungart-Rieker, 1999; Calkins & Dedmon, 2000; Cole, Martin & Dennis, 2004) to provide converging evidence for the presence of emotional self-regulation as distinct from emotional expression. Incorporating these additional measures in the current study was not a viable option, given the limited time and scope of this project. However, in future studies, the method of analysing real-time verbal mediation of behaviour used in this study, should be systematically applied to investigate the fine temporal interactions between speech and regulatory behaviour concerned with the social, emotional and motivational domains together with the cognitive domain, to gain a full picture of regulation in the early years of childhood.

8.2.3 Cross-sectional and longitudinal observations across younger and older age-groups

This study used a novel methodological approach to examine several features of spontaneous speech in conjunction with goal-related behaviour in naturalistic settings, such as, the fine temporal order of speech with respect to behaviour, contextual functions of social and private speech which were derived by applying the Contextual Model of Verbal Mediation to the particular goal-sharing

context of this study, different levels of complexity and sophistication of verbal mediation of behaviour, etc. However, due to the exploratory nature of this study, these features were only examined in a small group of 3-4 year-old preschool children. Extending the investigation of these features of speech and behaviour in studies with a cross-sectional and longitudinal design could better examine developmental change that is at the heart of the study of mediation, as proposed by Vygotsky. In particular, examination of verbal mediation of behaviour in younger children (2-3 year-olds or younger) with emerging language abilities, could provide a greater insight into this phenomenon, when the relation between language and behaviour is more transparent and externalised.

8.2.4 Observations in other settings

In this study, children were observed in the naturalistic setting of the classroom as well as in a laboratory-based task, and temporal patterns of behaviour, displayed by the *high* and *low self-regulatory groups,* were found to be similar across the two settings. However, observation of behaviour in other naturalistic settings outside the classroom, such as the home, playground, etc., was not carried out. Moreover, while peer interaction in classrooms is an ideal backdrop for examining verbal mediation in a social context, young children may still be inhibited in settings outside their homes. Mother-child interaction in the early years of childhood could provide a rich background for examining several developmental aspects of verbal mediation of behaviour, especially due to the proposed social origins of mediation.

8.2.5 Group as a unit of analysis: shared regulation

Even though self and other-regulation was examined in a social context in this study, the analyses were carried out from the perspective of an individual child, as the unit of analysis. Hence the influence of the shared nature of goals was only seen on the speech and behaviour of the focal child. However, as has been suggested by many researchers (Grau & Whitebread, 2012; Greeno, 2006; Nolan & Ward, 2008), investigations into the truly social modes of regulation in collaborative contexts also need to study the phenomenon at the level of the group, with the group being the unit of analysis. Such a multi-level analysis can also enable a more systematic investigation of the direct and indirect *means of action* of speech (as a *process of* speaking or as a *product* of speech) that were carried out in this study. Particularly, such an approach would have enabled a systematic observation of the indirect effects of speech as a *product,* on oneself, on other members of the group

and on the dynamics of the group as a whole. Such an approach is highly recommended for future research in this area.

8.3 Findings

This section summarises the general results of this study, which are relevant to all subsequent research questions, followed by the findings obtained for each of the three research questions.

8.3.1 General Results

The general results of this study pertain to the development of a new coding framework for the study, with the aim of examining the fine temporal relationship between spontaneous speech and self-regulation within goal-directed behaviour, while also enabling the examination of the task and social context relevant to the overarching goal of the behaviour under observation. The individual codes used in this study came from a critical review of the existing literature in the area of self-regulation and private speech research, as well as several other relevant fields such as second-language learning, the pragmatic approach to speech and the theory of speech acts, social modes of regulation in collaborative contexts and the language of pretend play. While some of the codes were used directly from the above-mentioned fields of research, most others were adapted or developed to suit the needs of the study and the age-group under observation. However, bringing together these diverse classification systems into a single coding framework, for the purposes of this study, not only brought about a novel amalgamation of diverse research areas, but also placed them in the service of the goal of observing young children's behaviour in a temporally dynamic and contextually sensitive manner, in both a naturalistic classroom setting and a laboratory-based task. The coding framework with its various components are outlined below.

The coding framework : an outline

The coding framework developed in this study comprised two kinds of categories, namely, *contextual categories* and *behavioural categories.* While the contextual categories coded continuous periods of behaviours, the behavioural categories identified discrete instances of behaviour and speech.

Through each of the three contextual categories (*degree of goal-orientation, adult involvement* and *goal-sharing context*) one could identify a particular continuous context of interest, that spanned a

fixed period of time. Through the category of *degree of goal orientation* consisting of four codes (*child absent, wandering behaviour, focused activity* and *goal-oriented episode*), a continuum of purposeful, goal-oriented behaviour was mapped onto the recorded episodes of each child. This enabled the selection of periods of behaviour exhibiting the highest level of goal-orientation, namely, the *goal-oriented episodes,* wherein children's self-regulation was observed. Through the category of *adult involvement* (*adult involved, adult uninvolved* and *adult absent* (lab only)), only those periods of the children's behaviour were selected which did not feature direct adult involvement. Hence, those periods of the recorded behaviour which fulfilled the criteria of *goal-oriented episodes* AND *adult uninvolved (OR adult absent* in lab only) were finally selected for all further analyses in the study. The category of *goal-sharing context* classified each goal-oriented episode as being governed by a personal (*I_goal*) or a shared goal (*we_goal*), thus bringing the influence of the shared or personal nature of the goal into consideration, for this study.

The behavioural categories, on the other hand, identified discrete instances of verbal and non-verbal behavioural events that occurred in the recorded behaviour of the young participants of the study. Hence, three types of non-verbal goal-related behaviours (*goal-directed behaviours, goal-mapping behaviours* and *goal-relevant events*) and spontaneous speech utterances classified according to three independent dimensions of speech (*pragmatic content, relevance to task* and *directed & adapted to*), were identified and recorded through the coding framework.

8.3.2 Research Question 1

Research Question:

Does the context of shared versus personal goals influence the occurrence of private and social speech during goal-oriented episodes?

The first research question enquired whether the children observed during the goal-oriented episodes in the classroom produced private and social speech differently in the context of a shared goal (we_goal) and a personal goal (I_goal). This was a preliminary question prefacing all subsequent research questions in the study, since all further data analyses were based on the results obtained for this question. In order to rule out the effect of peer presence in these results, only those personal goals which were pursued in the presence of others were analysed and compared with the shared goal episodes in all further analyses. It was hypothesised that children in the context of a personal goal would only exhibit goal-directed self-regulation and communication with others,

since the goal was not shared with others. In the context of a shared goal, children would exhibit both goal-directed self-regulation and regulation of others towards the shared goal, as well as communication with others. Based on the premise of the Contextual Model of Verbal Mediation (proposed in the **Literature Review, Section 2.5.2.3)** that the functions of private and social speech are not strictly limited to self-regulation and communication, respectively, it was hypothesised that both social and private speech would be produced in similar quantities in each context, but may be carrying out different functions, as required in each goal context. Hence there would be no quantitative difference in the two types of speech between the two contexts, in their rate of production per minute (RpM). However qualitative differences in the way speech utterances would occur in conjunction with certain types of goal-related behaviour between the two goal contexts was predicted, particularly due to the need for regulating others directly or indirectly in the shared goal context, as opposed to the personal context. Although, ideally, qualitative differences can be best revealed through differences in real-time temporal co-occurrence of speech and behaviour, it was reasoned that if a method based on correlational data itself was able to demonstrate a difference in the type of speech and behaviour relation in the two goal contexts, it would be sufficient evidence for factoring in the goal context in all further data analyses. Hence, the dataset would have to be separated between episodes with a personal or a shared goal, before carrying out any further analyses.

No significant differences were found for the rate of task-relevant private speech and social speech, between the I_goal and the we_goal contexts. Social speech in both goal contexts was higher than private speech, as was expected by the low rate of private speech reported in most private speech studies. Hence, as predicted, no quantitative differences were found in the amount of speech produced in the two goal contexts.

Comparison of correlational coefficients between overall speech and particular goal-related behaviours in the two goal contexts did reveal significant differences, for both private and social speech in relation to certain behaviours. For private speech, the correlation between overall private speech and the goal-relevant event, *goal attained,* was higher in the we_goal context as compared to the I_goal context. However, this difference between the two contexts was due to a significantly strong negative correlation between the particular speech-behaviour pair in the I_goal context, and a non-significant positive correlation in the we_goal context. Hence, due to a negative correlation, no conclusion could be drawn about the nature of temporal relation between overall private speech and *goal attained* behaviour in the I_goal context.

For social speech, the correlations between overall social speech and the goal-directed behaviours, *change strategy* and *notice issue/error,* were higher in the we_goal context, as compared to the I_goal context. This difference was driven by the strong positive correlation between overall social speech and the two goal-directed behaviours in the we_goal context. The conclusions based on differences in correlational coefficients can at best be tentative, without being further corroborated by evidence from real-time temporal co-occurrence. Given this premise, it may be tentatively assumed that in an episode with a shared goal, goal-directed behaviours like *change strategy* might create the need to either convey to others through social speech about the goal-relevant changes being made in the shared activity. In the case of *notice issue/error,* the recently noticed goal-related error, might prompt the child to use social speech, to both convey the noticed error as well as regulate others in correcting the error to attain the shared goal. Episodes with a personal goal may not require the child to either inform others about a goal-relevant issue or regulate others towards a goal that only concerns the child herself. Therefore, based on this preliminary analysis, it may be concluded that both private and social speech demonstrate differences in their temporal relation with certain types of goal-related behaviours, depending upon the personal or shared nature of the goal of the episode. It may be noted here that all the episodes analysed above for each child involved the presence of other peers in the immediate vicinity of the classroom, even if the goal being pursued by the child was personal in nature. Thus, even within the context of social presence of other peers, it was the personal or shared nature of the goal of an activity from the perspective of the child, which influenced the temporal interaction between speech and behaviour. Hence, considering the mere presence of others in the vicinity may not necessarily be enough in determining the nature of influence that the social context would have in speech production, and its relation with behaviour. One would have to consider how the child perceives this presence in her goal-directed activity, as it may be the *sharedness* of the goal which is the determining contextual influence on how she may employ speech in conjunction with goal-directed behaviour and goal-related events. While this study did not analyse the effect of adult presence in speech production, other studies have reported varying results. While some studies have shown that private speech production is suppressed in the presence of a teacher (Berk & Garvin, 1984; Krafft & Berk, 1998; Winsler *et al*., 2000), others have reported a greater production of private speech in the presence of a non-interactive adult in an experimental setting (Goudena, 1987; McGonigle-Chalmers *et al.,* 2014). The key to understanding these conflicting reports may again lie in considering the nature of involvement of the adult in the child's activity. This may determine not just the amount of private and social speech produced, but more crucially, the type of speech produced in conjunction with

particular types of behaviour, that may concern the adult from the perspective of the child.

Hence in all further analyses in this study, the goal-oriented episodes recorded for each child were separated on the basis of their goal-sharing context. Subsequent analyses carried out in the second research question, based on real-time temporal interaction between speech and behaviour types, further corroborated this finding, and revealed the ways in which the goal-sharing context had an effect on the role of speech in mediating behaviour.

8.3.3 Research Question 2

<u>Research Question:</u>

What is the role of task-relevant private and social speech in the verbal mediation of behaviour in the two goal-sharing contexts?

The second research question built upon the findings of the first research question, to determine the nature of temporal interaction between children's spontaneously produced task-relevant speech (social and private) and their goal-related behaviours within naturalistic goal-directed activities, governed by personal or shared goals. The first aim of the question was to determine whether there was indeed any evidence of real-time verbal mediation of behaviour, and if there was, whether the rates of production of speech and behaviour only correlated within a goal-directed activity, or co-occurred in real-time in a regular patterned manner. Could the specific content and timing of the co-occurring speech and behaviour indicate real-time verbal mediation of behaviour?

In order to address the first part of the question on establishing the presence of real-time verbal mediation of behaviour, Spearman's rank correlation coefficients were computed between the nine pragmatic categories of speech and the various goal-related behaviours. This was followed by t-pattern searches within goal-oriented episodes, in order to determine the repeated temporal co-occurrence of the speech and behavioural categories within t-patterns, in the magnitude of milliseconds to a few seconds. Hence significant correlations (p<.01) and co-occurrences within t-patterns between all the speech-behaviour pairs were compared. The comparison revealed several speech-behaviour pairs which were significantly correlated but did not repeatedly co-occur within t-patterns. This phenomenon of *correlation without co-occurrence* was mostly seen with private speech utterances in both I_goal and we_goal contexts, while only the goal-directed behaviour *seek help* was correlated with overall social speech in the I_goal context, without co-occurring in a t-

pattern. One technical reason for such a finding could be the larger number of social speech utterances compared to private speech utterances, which would have enabled the detection of social speech utterances within the t-patterns. For private speech utterances under this condition, most of the behavioural categories with which they were correlated were not directly involved in goal-attainment (except *regulate others*). The categories were mostly goal-relevant events such as *distraction, regulated by others* and *facilitated by others,* or goal-mapping behaviours such as *return to previous goal* and *start focused act.* These results could be explained by the possibility of verbal mediation of a trait or aptitude operating on a longer timescale, rather than on immediate behaviour in real-time. However, due to the limited scope of this doctoral project, this could not be further investigated. Hence it was concluded that correlation between task-relevant speech and behaviour was not a sufficient condition for establishing real-time verbal mediation of behaviour, thus underscoring the inherent limitation of correlational findings in private speech research.

There were a few behavioural categories (*new goal pursuit, goal attained & change strategy*) in relation to overall speech that displayed *co-occurrence without correlation* in the ps_I_goal, ps_we_goal and soc_we_goal conditions. These results were attributed to Type I detection error of false presence, because of the over-representation of these behaviours in the recorded datasets.

Finally, those speech-behaviour pairs which appeared under the condition of *correlation with co-occurrence* in all goal contexts, were considered to be a necessary condition for establishing real-time verbal mediation of behaviour. However, this was not considered to be a sufficient condition yet. Only those speech-behaviour pairs within this condition which could display meaningful verbal mediation of behaviour through a detailed contextual analysis of the actual instance of the t-pattern in the real-time data, could be considered to exemplify real-time verbal mediation of behaviour. Hence the phenomenon of *correlation with co-occurrence* coupled with contextual analysis of the speech and behaviours in real-time was considered to be the necessary and sufficient condition to establish the presence of real-time verbal mediation of behaviour.

The second part of the research question examined the nature of the established real-time verbal mediation of behaviour. In order to investigate this issue, the Contextual Model of Verbal Mediation (proposed in **Chapter 2**) was applied to the goal-sharing context of this study, to predict three types of contextual functions of speech with respect to the co-occurring behaviour - *goal-directed regulation of behaviour (self* and *others), communication for managing situations* and *communication for informing others*. Furthermore, based on the *timing of speech* as *preceding* or

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following the co-occurring behaviour, two types of verbal mediation of behaviour, namely, *verbal control* and *verbal commentary,* respectively, were also proposed. Hence specific speech profiles combining the four attributes of speech featured in the model (form of speech - *private* or *social,* timing of speech - *preceding* or *following,* site of action - *self* or *other* and means of action of speech- *process* or *product*), were predicted for private and social speech in each goal context, depending upon the contextual function being fulfilled by speech under each context.

Examination of the specific goal-related behaviours related to various pragmatic categories of speech under the phenomenon of *correlation with co-occurrence* in each speech-goal condition (ps_I_goal, ps_we_goal, soc_I_goal and soc_we_goal), revealed the presence of the three contextual functions which had been predicted by the Contextual Model. Further, actual instances of the t-patterns containing the speech-behaviour pairs under each of the three contextual functions were contextually analysed in the real-time datasets. The analysis confirmed the presence of two types of verbal mediation, namely, *verbal control* and *verbal commentary,* based on the timing of speech with respect to the co-occurring behaviour. Hence the contextual analysis of speech utterances *preceding* goal-directed behaviours indicated verbal mediation in the form of *verbal control,* wherein the speech utterances carried out specific functions such as verbally guiding subsequent behaviour, placing verbal emphasis on goal-relevant information prior to a goal-oriented control strategy, etc. On the other hand, speech utterances *following* goal-directed behaviours indicated verbal mediation in the form of *verbal commentary,* wherein the speech utterances carried out the function of reporting the errors or task-relevant issues noticed through previous monitoring behaviour, which in turn verbally guided a change in goal-directed control strategy. Vygotsky (1934/1986) had predicted an age-related change in the temporal order of children's private speech with respect to their behaviour. He proposed that private speech usually follows behaviour in younger children and is spoken as an afterthought or accompanying commentary, and its temporal order changes to speech preceding behaviour in older children, as it performs a verbal planning function (refer to **Section 2.5.5.** in **Chapter 2**). The assumption underlying this hypothesis is that speech which follows behaviour is performing a developmentally less mature function of commenting on previous behaviour, while the planning function performed by speech which precedes behaviour is more mature and goal-directed. However, the goal-directed function of *verbal commentary* revealed through the contextual analysis carried out in this study, showed that it did not merely report or comment on previous behaviour, but in fact, strategically verbalised the errors or issues noticed earlier, and hence externalised the error detection and problem-solving process. This

brought about a subsequent change in strategy, and hence occurred in tandem with *verbal control* of subsequent behaviour. Thus, task-relevant *verbal commentary* may be an integral part of the process of verbal mediation of goal-directed behaviour, and not merely a developmentally immature feature of speech function. The fact that such a developmental trend hypothesised by Vygotsky has never been confirmed by others studies (Berk, 1992; Berk & Spuhl, 1995; Patrick & Abravanel, 2000, Matuga, 2003; but for an exception see Kohlberg *et al.,* 1968) may be an indication of this erroneous assumption.

The analysis also revealed the presence of the specific speech profiles under each contextual function, as had been predicted by the Contextual Model. The various speech profiles represented both types of action of speech on behaviour - direct action through speaking as a *process* and indirect action through speech as a *product.* Hence, private speech, directed at and adapted for oneself, acted directly on the *self* through the *process* of speaking, and indirectly on *others* through the appropriation of the meaning of speech as a *product.* Similarly, social speech, directed at and adapted for others, acted directly on *others* as a *process* and indirectly on the *self* as a *product.*

Hence private speech utterances in the I_goal and the we_goal contexts were found to perform *goal-directed regulation of own behaviour* for regulating oneself directly, and *goal-directed regulation of others' behaviour* for regulating others indirectly in the we_goal context. Social speech utterances in the we_goal context also performed the function of *goal-directed regulation of others' behaviour,* by directly regulating others towards the shared goal. As was predicted, social speech in the I-goal context did not perform any goal-directed regulation of others, due to the personal nature of the goal. On the other hand, social speech utterances in both the goal contexts performed the two communicative functions - *communication for managing situations* and *communication for informing others.*

Hence the findings validated the Contextual Model of Verbal Mediation, as well as its basic premise that there can be no *a priori* functional differentiation between private and social speech, with private speech limited to a cognitive/self-regulatory function for the self and social speech limited to a social/communicative function for others. Similarly, the practice of assigning functional significance to the semantic content of speech was also refuted by the findings of the study, since the classification of speech adopted in this study, according to its pragmatic content did not show any simplistic correspondence between the pre-assigned speech content and the speech functions derived from the contextual analyses of co-occurring speech and behavior. The findings instead

demonstrated that the function of speech, be it private or social, depended on the particular conditions under which it was produced. Only a detailed temporal and contextual analysis was able to determine its function. Moreover, addressing the pertinent question raised in private speech research - "Is task-relevant private speech always self-regulatory?", the findings of this study demonstrated that apart from being directly involved in *goal-directed regulation of behaviour* (both for the *self* and for *others*), task-relevant private speech may also perform other communicative functions (such as *communication for managing situations* and *communication for informing others)* which are relevant to the flow of the task, but not necessarily involved in the attainment of the goal of the task. These additional functions may be emotional, motivational or social in nature, but nonetheless, important for the child during the process of goal-attainment.

8.3.4 Research Question 3

Research Question:

Are there any consistent individual differences in the verbal mediation of behaviour through private speech?

The final research question enquired whether the children displayed consistent individual differences, in the ways in which they verbally mediated behaviour across the two settings (classroom and laboratory), using private speech. Previous studies have examined individual differences in children through difference in the rate of production of private speech in relation to relevant behavioural constructs in individual children across different time points, tasks and settings (Berk & Landau, 1993; Lidstone, Meins & Fernyhough, 2011; Winsler *et al.,* 2003; refer to **Section 2.5.7** in **Chapter 2** for a discussion on this issue). This study, instead, focused on the qualitative styles of private speech use in the verbal mediation of behavior.

However, due to the small number of participants in the study, group differences rather than individual differences were examined through this research question. Hence, to begin with, the children were divided into two groups - *high* and *low,* on the basis of the frequency of patterned behaviour involving speech and goal-directed behaviour observed in the classroom. This division could also be understood to represent degree of verbal mediation of behaviour, as expressed in the recurring speech and behaviour t-patterns. Before proceeding to detailed analyses of qualitative individual differences, the quantitative aspects of this phenomenon were investigated by examining

the consistency of group membership (*high* or *low group*) between the frequency of all speech patterns (*frequency of speech patterns*) and the measure of unique speech patterns (*PattDiff_speech)*, the measure of self-regulation in the classroom (*SR score_class*), self-regulation in the laboratory-based 'tidy-up' task (*SR score_lab*), performance in the task (*task performance score*) and overall self-regulation and task performance in the laboratory (*total lab score*). The comparisons revealed considerable (though not absolute) consistency in group memberships when compared with the first measure. Thus, those children who exhibited a higher degree of verbal mediation of behavior, more often than not, showed a higher degree of successful self-regulation in the classroom and the laboratory settings and better task performance in the laboratory-based task. Hence the employment of verbal mediation of behaviour was indicated to be a successful strategy used by the children during goal-directed behaviour, in both the settings.

One finding of note here was that the measure of talkativeness (rate of goal-relevant speech produced in the classroom per minute) was not related to other measures of patterned behaviour involving speech, as well as the self-regulation and performance scores. Some studies in private speech literature have shown some degree of correlation between overall talkativeness of a child and measures of private speech use (Fernyhough & Fradley, 2005; McGonigle-Chalmers *et al.,* 2014). However the findings obtained in this study indicated that children who were more talkative generally, did not employ private speech strategically in conjunction with goal-related behaviour, to carry out successful verbal mediation of goal-directed behaviour. Hence, as has been suggested by others (Winsler *et al.,* 2003), it is the strategic use of private speech rather than simply producing more private speech, which may be the key to successful self-regulation in children.

Detailed contextual analysis of private speech patterns unique to the *high* and the *low group* revealed qualitative differences in the way children in each group exhibited verbally mediated self-regulation during the goal-directed episodes, in the classroom and the laboratory. Children in the *high group,* across both the settings*,* displayed more sophisticated forms of verbal mediation of behaviour involving error monitoring verbalised through *verbal commentary* and error correction brought about through *verbal control* of relevant behaviour. Children in the *low group,* however, simply employed *verbal commentary* to report routine goal-directed strategy or negatively evaluated one's ability after facing a failure, which was followed by quitting behaviour. Hence these findings suggest that even when children recurrently employ verbal mediation of behaviour during their goal-directed behaviour, it may not translate into successful self-regulation, simply due to the use of lower levels of verbal mediation of behaviour, as displayed by the *low group.*

8.4 Contributions

This section of the chapter discusses the various theoretical, methodological and educational contributions of this study, derived from the novel approach and findings obtained from the general results and all three research questions. While most of these contributions have already been discussed in the previous section of this chapter, in the context of the findings of this study, they will be systematically highlighted here under the three spheres of contribution, for the sake of greater clarity and visibility.

8.4.1 Theoretical contributions

8.4.1.1 Contextual Model of Verbal Mediation

A new model for understanding real-time verbal mediation of own and other's behaviour was proposed in this study, and was validated through the findings obtained. The Contextual Model of Verbal Mediation is based on the premise that the function of speech with respect to behaviour is dependent on various features of speech as well as the specific task/goal context in which the speech is produced. Hence, the model refutes the common practice in most private speech studies that assign *a priori* functions to speech on the basis of - who it is directed to (i.e., social speech is communicative and affects others while private is self-regulatory and affects the self), the timing of speech (i.e., speech that precedes behaviour is mature and solution-oriented while speech that follows behaviour is immature and not solution-oriented), the semantic content of speech (i.e., certain task-relevant statements have a planning function while others have a non-planning function), etc. Instead, the model puts forth four features of speech which combine in various ways to determine eight different speech profiles. The four features of speech are the *form of speech* based on who the speech is directed to and adapted for (*private* or *social* speech), *timing of speech* based on the temporal order of speech with respect to the accompanying relevant behaviour (*preceding* or *following* behaviour), *site of action of speech* based on who does the speech have an effect on (*self* or *other*) and *means of action of speech* based on how does the speech produce its effect (directly through the *process* of speaking or indirectly through the *product* of speech).

The model was applied to the particular goal-sharing context of this study, wherein children produced spontaneous social and private speech in the presence of others, in the classroom and the laboratory, during goal-oriented episodes, governed either by a personal goal or a shared goal. In such a context, three contextual functions of speech were predicted, namely, *goal-directed*

regulation of behaviour (self and *others*), *communication for managing situations* and *communication for informing others,* to be performed by particular speech profiles in the various goal-sharing conditions. The results obtained through the analysis carried out for the second research question validated these predictions (refer to **Section 8.3.3** of this chapter for the detailed findings), and hence confirmed that it is the temporal and contextual factors of speech with respect to behaviour, which can determine real-time verbal mediation of behaviour.

8.4.1.2 Influence of goal-sharing context during verbal mediation of behaviour

Most private speech studies have investigated the effect of social context on the rate of private speech production by using categories for classifying peer and adult presence. This study however investigated a different dimension of social context, namely, the personal or shared nature of the goal of the activity in which the child was involved, in the presence of other peers. Järvelä & Hadwin (2013) had proposed the concept of *I, you* and *we perspectives* for describing the spectrum of *sharedness* of goals in a collaborative context, and used them to define the three modes of regulation in a collaborative context, namely, *self-regulation, co-regulation* and *shared regulation.* Since the unit of analysis in this study was the focal child, and not the group or other peers, only self-regulation carried out by the focal child from an *I perspective* within a personal goal and from a *we perspective* within a goal shared with others was observed. Hence all goal-oriented episodes were classified according to their goal-sharing context, into episodes with an *I_goal* or a *we_goal.* This enabled an investigation into the effect of the *sharedness* of one's goals on not just the rate of speech production, but also the types of speech-behaviour co-occurrences within t-patterns, and the resulting functions of speech in the two goal-sharing contexts (refer to **Section 8.3.3** of this chapter for detailed findings). Hence these findings propose that the mechanism by which social presence may affect the nature of speech production in relation to relevant behaviour is the goal-sharing context of the task/episode which assigns different meanings to one's social environment, and determines how one will employ speech in such an environment. Hence future studies should consider the goal-sharing feature of social presence to arrive at more conclusive results regarding the effect of social presence on speech production.

8.4.1.3 Significance of the temporal order of speech and behaviour

Through a detailed contextual analysis of the temporal order of speech with respect to co-occurring behaviour in a t-pattern, the study confirmed the presence of two types of verbal mediation, namely, *verbal control* and *verbal commentary*. The contextual analysis of speech utterances *preceding*

goal-directed behaviours indicated mediation through *verbal control,* in the form of verbally guiding subsequent behaviour, verbalising goal-relevant information prior to a goal-oriented control strategy, etc. On the other hand, speech utterances *following* goal-directed behaviours indicated mediation through *verbal commentary,* in the form of verbalising the content of previous monitoring behaviour which in turn verbally guides a change in goal-directed strategy, describing previous task-related event or routine strategy, positively or negatively evaluating one's performance, task progress or task difficulty following moments of failure or difficulty, etc. The role of private speech that precedes behaviour has always been identified in the private speech literature to have a planning or guiding role (Vygotsky, 1934/1986; Kohlberg *et al.,* 1968; Berk & Spuhl, 1995; Patrick & Abravanel, 2000), as demonstrated in this study through the phenomenon of *verbal control*. On the other hand, these studies have often limited the role of private speech that follows behaviour to merely describing or reporting previously completed or ongoing behaviour as an afterthought, without attributing any goal-directed function to such utterances. However in this study, *verbal commentary,* in some instances, was designated as a goal-directed process of verbal mediation acting in tandem with *verbal control,* when it co-occurred and followed monitoring goal-directed behaviours such as *check progress* or *notice issue/error.* Contextual analysis of such co-occurrences revealed that such utterances externalised the error detection function of the monitoring behaviours and through the process of speaking aloud, further emphasised the detected error and guided the individual's behaviour to correct the error accordingly. This can be understood as a refutation of the 'conduit metaphor', which treats speech as a passive conduit or container of our mental content. Instead, the goal-directed nature of *verbal commentary* can be better comprehended if we understand speech to be a mental activity itself, which through the process of speaking, transforms one's thinking and consequent action. Hence the verbalisation of the noticed error actively steered the process of error detection towards error correction.

8.4.1.4 Verbal mediation of behaviour : a successful strategy for self-regulation

The findings in the study demonstrated consistency of group membership (*high* and *low group*) across the measure of the frequency of deployment of verbal mediation represented by frequency of patterned behaviour involving task-relevant private speech and goal-directed behaviour in the classroom (*frequency of speech patterns),* the measure of self-regulation in the classroom (*SR score_class*) and overall self-regulation and task performance in the 'tidy-up' task in the laboratory (*total lab score*). Hence, those children who employed verbal mediation of behaviour more frequently also displayed more successful self-regulation in comparison to failures of self-

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regulation and performed better in the 'tidy-up' task. Furthermore, qualitative analysis of the unique patterns of private speech and behaviour in each group, across the two contexts, also revealed different levels of sophistication of verbal mediation of goal-directed behaviour. Hence while the *high group* displayed both *verbal control* and *verbal commentary* as means of verbal mediation of behaviour, the *low group* only displayed *verbal commentary*. The nature of *verbal commentary* displayed by the children in the two groups was also different. In the *high group*, *verbal commentary* co-occurred with monitoring behaviour and was considered to be goal-directed as it worked in tandem with *verbal control*. In the *low group, verbal commentary* either co-occurred with routine strategic behaviour or after a moment of failure, to negatively evaluate one's ability or performance. Hence the quantitative and qualitative differences between the two groups in terms of the frequency, sophistication and goal-directedness of verbal mediation of behaviour, indicated that verbal mediation of behaviour, as displayed by the *high group,* was indeed a successful strategy for self-regulation of goal-directed behaviour.

8.4.2 Methodological contributions

8.4.2.1 Observing the process of self-regulation directly

Spontaneously occurring self-regulation in the context of goal-directed behaviour was directly observed in this study, instead of using variables like task difficulty, task performance or other indirect measures of children's behaviour as proxies for self-regulation which have been previously used in private speech studies (refer to **Section 2.4.1** of the Literature Review for a discussion on the limitations of using proxies for measuring self-regulation in private speech studies). Hence this is the first study of its kind to directly measure the observable processes of self-regulation exhibited by the children during the same goal-oriented activities in which their spontaneous speech was also recorded, instead of measuring the end product of assumed self-regulation. Moreover, children were systematically observed as they exhibited self-regulatory behaviour, instead of relying on self-reports, questionnaires or teachers' and parents' descriptions. Most contemporary models of self-regulation have relied on such indirect measures or self-reports given by older children and learners (refer to **Section 2.2.1.4** for a critique of these models which are not modeled on younger children's behaviour or direct observations). Hence this study adds to a very recent trend of using methods of direct systematic observation of young children, for exploring the construct of self-regulation much earlier in development (Whitebread *et al.,* 2009; Bryce & Whitebread 2012).

8.4.2.2 Systematic observation of self-regulation in diverse activities

The behavioural category, *goal-directed behaviours,* was developed in the coding framework, in order to observe self-regulation during a goal-oriented episode. The two complementary self-regulatory processes of *control* and *monitoring* (Nelson and Narens, 1990) were operationalised into several goal-directed control strategies (*routine strategy, change strategy, search strategy, regulate others* and *seek help)* and goal-directed monitoring strategies (*check progress, notice error/ issue*). A code representing an active failure of self-regulation (*repeat failed strategy*) was also incorporated into this category. These codes were successfully applied to observe children's self-regulatory behaviour during open-ended, child-initiated classroom activities as well as during the laboratory-based 'tidy-up' task. Since all the codes had been defined with reference to the goal of the activity under observation, the varying content of the goal of the activity did not make a difference to the systematic manner of observation. Hence, this addressed the issue of methodically observing some core common features across diverse open-ended activities (refer to **Section 2.4.3** for a discussion on the problem of observing naturalistic open-ended activities).

8.4.2.3 Mapping the context of goal attainment

Apart from the category of *goal-directed behaviours* employed for observing self-regulatory processes in a goal-oriented episode, two additional categories, namely, *goal-relevant behaviours* and *goal-relevant events,* were also incorporated into the coding framework. The codes under the category of *goal-mapping behaviours* (i.e., *new goal pursuit, return to previous goal, leave goal pursuit, start focused activity* and *start wandering behaviour*) comprised those behaviours of the focal child which recorded the chid's activity in relation to the pursuit of the goal. The codes under the category of *goal-relevant events* (i.e., *distraction, disruption, failed strategy, regulated by other, facilitative event, goal attained* and *failure to attain goal*) recorded significant events which might indirectly influence the course of the goal-oriented episode, but not directly involved in the process of goal-attainment. Hence these codes mapped out the entire scenario of self-regulatory behaviour in the context of any task/activity, as well as all the distractions and relevant events that might influence the self-regulatory behaviour of children as they respond to these events spontaneously. Such an in-depth coding system enabled a finer and richer temporal and contextual analysis of the speech and behaviours that co-occurred during these episodes.

8.4.2.4 Development of a procedure to examine real-time verbal mediation of behaviour

One of the principle aims of the study was to investigate the role of speech in influencing goal-directed behaviour, in the context of real-time verbal mediation of behaviour. Hence a novel methodological procedure was developed in this study to identify moments of verbal mediation of behaviour in real-time during the recorded behaviour of the children. The first step in this procedure was the calculation of correlations between task-relevant speech and goal-related behaviours during the recorded goal-oriented episodes. This was followed by conducting t-pattern searches within these episodes, with the same speech and behaviour events, to extract significantly recurring patterns of task-relevant speech and goal-related behaviours. Thus, all combinations of speech-behaviour pairs were compared for their significant correlation and co-occurrence in a t-pattern, and only those speech-behaviours which fulfilled the condition of *correlation with co-occurrence* were selected. The selected speech-behaviour pairs were then traced back to the t-patterns in which they co-occurred together. Specific instances of these t-patterns were identified in the real-time recorded data of the children, and those instances in the recorded data were then analysed in the broader context of the task and other significant events surrounding these speech-behaviour pairs to reveal real-time instances of verbal mediation of behaviour. Development of such a temporally and contextually sensitive procedure has been called for in both areas of research, namely, private speech (Alderson-Day & Fernyhough, 2015; Atencio & Montero, 2009; Matuga, 2003) and self-regulation (Molenaar & Järvela, 2014; Winne, 2014; Knight, Wise, Chen & Cheng, 2015).

This procedure also demonstrated the inadequacy of correlational data in determining real-time temporal interaction between speech and behaviour. Moreover, the findings of this study based on this procedure also validated the use of t-pattern analysis as an efficient tool to extract and examine temporally patterned behaviour in young children during their goal-directed activities.

8.4.2.5 New criteria for private/social distinction

Most private speech studies distinguish social speech from private speech on the basis of '*addressivity*' or '*directedness*' to others and to the self, respectively. Linguistic and paralinguistic cues such as use of names or pronouns, conversational turn-taking, eye contact, gaze direction, physical contact, etc., are considered while ascertaining the presence of this criterion. However many speech utterances appear to be addressed to another listener in a seemingly social conversation, but its contents are not adequately adapted according to the shared public knowledge between all the participants, such that it holds only a private meaning for the speaker. Hence such a

speech ultimately serves a private purpose, irrespective of the intent or addressivity of the speech. Several private speech researchers have pointed out the inadequacy of only using linguistic and paralinguistic cues to identify speech as social or private without analysing the content and context of the speech utterance to determine if it held a private meaning for the speaker (Girbau, 1996, 2007; Ramirez, 1992; Smith, 2007). Hence apart from the traditional criterion of '*directedness',* an additional criterion of *'adaptiveness'* for others was added to the system of classification of social and private speech in this study. This criterion was based on a contextual analysis of the speech utterance, and its relation with adjacent utterances, which identified private meaning in apparently social utterances and classified them as private speech. A 'substantial' inter-rater agreement of 0.79 (Cohen's Kappa) was achieved for distinguishing social and private speech based on the two criteria of *directedness* and *adaptiveness.* Hence, the inclusion of this additional criterion of *adaptiveness* is strongly recommended for future studies that aim to examine social and private speech in a contextually-situated manner.

8.4.2.6 Separating form/content of speech from its function

One of the major methodological issues in private speech research, which was addressed in this study, is the confusion between various dimensions (form, content, function, etc.) of speech, such that one dimension of speech (e.g., degree of internalisation - dimension of structural form) is assumed to also represent another dimension of speech (e.g., task-relevance - dimension of content). Certain early studies in private speech research, which aimed to identify the functions of private speech in relation to verbal mediation of behaviour (Feigenbaum, 1992; Frauenglass & Diaz, 1985), have been rightly critiqued (Frawley & Lantolf, 1986; Matuga, 2003) for assigning *a priori* functional categories to the certain forms of speech, such as its form or content.

Hence, deliberate steps were taken in the study to avoid any assumption of the function of speech without examining the actual instance in time when a speech utterance interacts with its neighbouring behaviour. Firstly, speech was classified according to three completely independent dimensions and without any inference of function. Hence all spontaneous speech was classified as follows - on the basis of 'directedness' and 'adaptedness' to the listener as *social* or *private;* on the basis of relevance or meaningful reference to the ongoing task, but not necessarily causal in the process of goal attainment, as *task-relevant* and *task-irrelevant;* and on the basis of the pragmatic content of speech derived from its context into nine *pragmatic categories of speech.* Secondly, all speech categories were coded independently from the behavioural categories, through two separate

rounds of coding. Care was also taken to classify all behavioural categories on the basis of non-verbal behavioural cues, and not involve any verbal indicators. Similarly, the pragmatic content of speech was coded on the basis of the 'intent' of the speaker at the time of producing the utterance, rather than any subsequent effect that such an utterance had on the listeners.

Finally, a theoretical framework in which these speech categories were assessed with respect to co-occurring behaviour was developed, titled here as the Contextual Model of Verbal Mediation. The model comprised four contextual features of speech, namely, the *form of speech,* the *timing of speech,* the *site of action of speech* and the *means of action of speech.* None of these features assumed any *a priori* function of speech with respect to behaviour. Hence, three contextual functions of speech (i.e., *goal-directed regulation of behaviour* (*self* and *others*), *communication for managing situations* and *communication for informing others*) in relation to verbal mediation of behaviour (of self and others) were derived in the study, by applying the above model to the goal-sharing context of the present study. Hence the various interactions of speech and behaviours occurring together in t-patterns, assessed within the specific goal-sharing and task-specific context of their co-occurrence were the basic unit of analysis for deriving the functions of speech during verbal mediation of behaviour. Hence, following such a rigorous method for deriving the function of a speech utterance is proposed by this study as essential for separating other dimensions of speech from the actual function of the speech utterance in relation to behaviour.

8.4.2.7 Examining failure in the context of self-regulation

Most studies in private speech research only examine the positive effect of private speech in relation to behaviour. Studies that examine the emerging skills of self-regulation in young children also tend to focus on positive instances of self-regulation, rather than failures of self-regulation (c.f. Bryce & Whitebread, 2012). However, it may be argued that examining failure in the context of self-regulation can provide critical insight into the rich and complex skill of self-regulation displayed by children in naturalistic settings.

The present study examined failure from various angles. Firstly, self-regulation was observed in response to moments of actual or potential failure. Furthermore, instances of failures of self-regulation itself were also recorded in the children through specific sequences of behaviour displayed by them. Finally, a potentially detrimental effect of speech in relation to behaviour, through patterns of speech and behaviour depicting low levels of verbal mediation of behaviour, was also examined in this study. Details of the ways in which this study examined these different aspects of failure are discussed below.

The focus of the present study was on the 'process' of self-regulation, rather than its end product. Hence, central to such an approach was the identification of moments of failure or difficulty within an activity, which triggered the display of spontaneous self-regulation in young children to either overcome, manage or avoid such situations. Such disruptive moments were explicitly coded in the data through categories such as *distraction, disruption, regulated by other, failed strategy,* and *failure to attain goal.* Some of these moments were externally generated, while others were a result of the behaviour of the children themselves. Contextual analysis of various speech utterances in conjunction with such behavioural categories led to the examination of young children's verbal mediation of behaviour in the face of real or imminent failure.

The coding framework of the study pertaining to behaviour also comprised certain codes which indicated a maladaptive response of the child to a challenging situation, such as, *failed strategy, repeat failed strategy, failure to attain goal* and *leave goal pursuit*. The *self-regulation score* calculated for all the children in the study, on the basis of their behaviour in the classroom and the laboratory dataset, was a ratio of instances of successful self-regulation to instances of failures of self-regulation. The instances of failures of self-regulation were mostly identified as specific

sequences of behaviour involving a potentially disruptive or challenging event followed by one of the maladaptive responses mentioned above. Four types of failures of self-regulation were identified in the children's behaviour, namely, *distractedness, quitting behaviour, externally regulated* and *perseveration.* An additional type of failure, coded in the context of the 'tidy-up' task in the laboratory was *goal neglect.* Such an approach of considering failures of self-regulation together with positive instances of self-regulation in the naturalistic behaviour of young children can lead to a more in-depth understanding of age-related changes and individual difference in the qualitative styles and levels of their self-regulation (Bryce & Whitebread, 2012).

Finally, contextual analysis of unique t-patterns displayed by children in the *low* self-regulating and performing group demonstrated negative instances of verbal mediation of behaviour, wherein *evaluative speech* in the form of a negative assessment of one's ability had a detrimental effect on the on-task motivation and cognitive behaviour of young children, ultimately leading the child to show an maladaptive response, such as *leave goal pursuit* (refer to **Section 7.4.4.2** for an analysis of **low_lab_pattern 3**). Identifying such negative patterns of speech and behaviour can be useful for charting the entire spectrum of verbal mediation of behaviour, from the outright detrimental, to the low-level automatic response leading up to more sophisticated forms of adaptive and successful mediation.

8.4.2.8 Development of a naturalistic laboratory-based task

The laboratory-based 'tidy-up' task developed and used in the present study was another important methodological contribution of the study towards observing young children in a naturalistic yet controlled environment. The 'tidy-up' task was designed to mimic a naturally occurring situation, routinely faced by the children, namely, 'tidying-up' their toys and play area. The tidy-up activity was positioned between two play sessions, in such a way as to render the task meaningful and self-motivating to the children. It was deemed necessary by the children to carry out the 'tidying' of the play area, as a part of the task, in order to clear the space for the new toys to be played in the next play session. In this way, the naturalistic quality of the task and children's motivated involvement in it was maintained. Another important feature of the 'tidy-up' task was the temporally extended nature of its goal, unlike most other laboratory-based tasks, which comprise short multiple trials of the same task set. Keeping a prospective goal in mind which can be achieved in the extended future is an important attribute of naturalistic, child-initiated activities, commonly observed in the goal-directed episodes recorded in the classroom setting. Hence the 'tidy-up' task was comparable to the

recordings in the classroom, due to its meaningful and self-motivating nature for the children, as well as the achievement of its pre-determined goal on a similar timescale as the classroom activities.

In the last research question, when consistency of group membership across different behavioural measures in the two settings was examined, children were found to belong to the same group across the two measures - *self-regulation score_class* and the *total lab score*. Hence the children's performance in the two settings were similar, thereby validating the claim that the variables used in the present study managed to measure the same underlying ability of the children, in the classroom and in the laboratory-based task. While this demonstrated that behavioural scores such as the *self-regulation score* and the graded *task performance score* for the 'tidy-up' task were able to capture the process of self-regulation, instead of its end product, it also confirmed the ecological validity of the 'tidy-up' task.

8.4.2.9 Development of behavioural scores

As mentioned in the previous section, two kinds of individual behavioural scores were derived from the self-regulatory behaviour displayed in the classroom and during the 'tidy-up' task and from the graded performance on various components of the 'tidy-up' task. These were the *self-regulation score (class* and *lab)* and the *task performance score,* respectively. Both the scores were based on the assessment of behaviour displayed throughout a goal-oriented episode in the classroom or the task in the laboratory, and not just based on a final assessment at the end of the episode or the task. Hence the focus was on the process of self-regulation, rather than its product. Even with the *task performance score,* which calculated performance as an aggregate of performance on the various sub-components of the task, failure in any component would not necessarily have meant an absence of any self-regulation strategies in achieving the goal. Hence, in order to obtain a more comprehensive picture of self-regulation employed within the task, the final behavioural measure for the laboratory was the *total lab score,* computed as a sum of the *self-regulation score_lab* and the *task performance score.* The use of such behavioural scores are more representative of actual self-regulation taking place in a task. These are certainly an improvement over the static and final measures of task performance usually employed in studies administering a task, which are, at best, a proxy measurement for the end product of self-regulation, in the case of an optimally challenging task (refer to **Section 2.4.1.1** for a discussion on the mediating role of task difficulty on the relation between self-regulation and task performance).

8.4.3 Educational contributions

8.4.3.1 Verbal mediation of behaviour in the classroom

Self-regulation in young children has been found to be related to a number of desirable academic outcomes, such as academic performance (Blair & Razza, 2007; Bull & Scerif, 2001; McClelland et al., 2000; McClelland et al., 2007; Normandeau & Guay, 1998; Stipek et al., 2010) and school readiness or successful school adjustment (Ladd & Prince, 1987; Rimm-Kaufman, Pianta & Cox, 2000; Blair, 2002). Hence, any improvement in self-regulatory skills of young children will be a welcome educational contribution from this area of research. In a meta-analysis of self-regulated learning training programmes taught in schools, Dignath *et al.* (2008) reported some improvement in self-regulation, particularly for younger learners, and involving verbal training programmes such as self-explanations (Siegler, 2002) and self-assessments (Black & Williams, 1996). Hence if self-regulatory behaviour is indeed teachable, and amenable to verbal mediation, then, interventions which operate on a shorter timescale, preferably in real-time, may be the most transparent and easiest to replicate through classroom-based pedagogies. However, before designing or delivering a particular intervention, it is crucial to understand the mechanisms underlying the intervention, as well as the role of contextual factors in facilitating or inhibiting such mechanisms. If indeed there is a normative way in which self-regulation operates, we first need to gain an insight into how it is situated and embedded in the daily classroom activities in which children are engaged.

The study provided such an insight into the process of real-time verbal mediation of behaviour through spontaneously produced social and private speech, in 3 to 4-year-old children. Detailed temporal and contextual analyses of the recurring speech-behaviour pairs within t-patterns revealed the complimentary process of *verbal control* and *verbal commentary* involved in goal-directed verbal mediation of behaviour. The findings of the study also demonstrated the role of both private and social speech, in the verbal mediation of one's own and others' behaviour, either directly as a *process* or indirectly as a *product*. The relevance of the specific findings of the present study to educational settings are discussed in the sections below.

8.4.3.2 Talking strategically: not just talking more

A finding of educational significance in the present study indicated that children who spoke more frequently, overall, did not necessarily exhibit a higher degree of verbal mediation of behaviour. Hence, it was the particular timing of task-relevant speech utterances in relation to goal-related

behaviours, rather than the sheer frequency of speech utterances, which was critical in determining the prevalence of t-patterns comprising speech and behaviour, and hence any real-time verbal mediation of behaviour. A longitudinal study by Vallotton & Ayoub (2011), examining the relation between toddlers' self-regulation and spoken vocabulary and talkativeness, also demonstrated that the vocabulary, and not the talkativeness of the toddlers, was a better predictor of their self-regulatory skills. Hence, while there is growing awareness amongst teachers and educators regarding the beneficial role of private speech use in the classroom (Winsler, Manfra & Diaz, 2007), it may be wrong to assume that children who speak more, would necessarily be employing verbal mediation of behaviour as a strategy in solving tasks or during general goal-directed behaviour. Hence, just encouraging children to talk in the classroom during problem-solving may not be a suitable approach for encouraging their verbal mediation of behaviour. However, on the other hand, teaching children to use rigid standard verbal scripts may also not be a solution (Winsler 1998; Winsler *et al.,* 2007). A mid-way approach can be teaching by example. Hence teachers and instructors can intentionally demonstrate their own strategic use of speech in the verbal mediation of goal-directed behaviour and problem-solving, as well as provide opportunities and activities in the classroom where the use of such strategic talk can be scaffolded and encouraged.

8.4.3.3 Identifying levels of verbal mediation

The findings of the study demonstrated distinct qualitative differences in the level of verbal mediation of behaviour. Hence, while the *high group* displayed both *verbal control* and *verbal commentary* in relation to control and monitoring behaviour, the *low group* displayed only *verbal commentary* in relation to routine goal-directed strategies, as well as an instance of negative evaluation of one's behavior mediating quitting behaviour after facing a failure. Hence if these differences can be understood to stand as markers of different levels of verbal mediation of behaviour, teachers and other educational practitioners can use these markers to identify children displaying different levels of sophistication and complexity of verbal mediation. Tailoring an intervention or teaching practice based on the level and nature of verbal mediation spontaneously displayed by a child may be more effective than using a one-size-fits-all approach.

8.4.3.4 Identifying failures and successes of self-regulation

While positive and successful instances of self-regulation may be easily identifiable in the behaviour of young children, educators can benefit most from the identification of failures of self-regulation. Hence sequences of behaviour demonstrating failures of self-regulation such as

distractedness, quitting behaviour, externally regulated, perseveration and *goal neglect* may highlight the maladaptive patterns of behaviour, usually adopted by children, which can be met with a failure. Hence, interventions targeted at highlighting and interrupting such detrimental patterns can also be a strategic step in promoting self-regulation in young children.

8.5 Conclusion

Ever since Vygotsky (1934/1986) proposed a self-regulatory function of private speech in young children, through the process of verbal mediation of behaviour, research in private speech has largely supported his central thesis (Berk, 1986; Fernyhough & Fradley, 2005; Kohlberg *et al.,* 1968; Winsler *et al.,* 2003), through significant statistical correlations between production of private speech and behavioural constructs which indicate self-regulation of behaviour. However if verbal mediation of behaviour through private speech indeed takes place in real-time, then, surprisingly little is known about the nature of spontaneous real-time temporal interaction between speech and behaviour in naturalistic settings. Hence, to address this issue, a novel methodological approach was developed in this study to examine instances of real-time verbal mediation of behaviour in young children in the naturalistic environment of a preschool classroom and in the controlled environment of a laboratory-based task. This involved coupling correlational findings with temporal co-occurrences established through t-pattern analysis, to extract those speech-behaviour pairs from the observational data which were confirmed to interact in real-time. However all real-time interactions of speech and behaviour are not necessarily instances of real-time verbal mediation of behaviour. Hence, the correlating and co-occurring speech-behaviour pairs were then contextually analysed, by considering the temporal order of the interaction between speech and behaviour, the shared or personal nature of the goal of the activity which determined the social context in which the interaction was situated, and the specific interpersonal dynamics of the activity under observation. Such an in-depth contextual analysis revealed not only the instances of real-time verbal mediation of behaviour in the recorded data, but also demonstrated the presence of different levels of verbal mediation of behaviour, characterised by their degree of sophistication and efficacy in successfully regulating goal-directed behaviour.

This study also fulfilled two important requirements for testing out the novel methodological approach described above. The first requirement was a suitable theoretical framework for understanding real-time verbal mediation of one's own and others behaviour through spontaneous speech. Hence, the Contextual Model of Verbal Mediation was developed and validated in this

study to propose the various means by which both social and private speech can mediate one's own and others' behaviour in real-time. The concept of the dual nature of speech, acting through the *process* of speaking and as a *product* of speech, was applied to this model, to delineate both direct and indirect means, respectively, by which speech may act on behaviour. Hence the model sought to expand the current understanding of the mechanisms by which private speech regulates one's own behaviour, to include mediation through social speech, of *self* and *others*, both directly as a *process* and indirectly as a *product*, and through speech both *following* and *preceding* behaviour.

The second requirement was a suitable system of coding events in the recorded data, which would support the fine temporal and contextual analysis of the data, as proposed by the novel methodological approach. Hence, unlike most private speech studies, this study was the first of its kind to simultaneously record both spontaneously produced speech as well as directly observable goal-directed behaviour of the children during the same activity. In order to faithfully observe real-time verbal mediation of behaviour, speech and behavioural events had to be recorded at the correct time-scale. Hence goal-directed strategies were coded with a suitable frequency to register all possible instances when speech may interact with behaviour. Moreover, a fine-grained contextual analysis was made possible by additionally coding goal-relevant events and goal-mapping behaviours which charted the entire process and context of goal-attainment. Hence through this, all possible goal-related external events and behaviours which could trigger verbal mediation of behaviour were recorded. The system for classifying speech was also based on the surrounding context of speech, in determining all the three dimensions of speech that were coded in this study. Hence, speech was differentiated into social and private on the basis of the twin criteria of *directedness* and *adaptiveness* for self or other, determined by the overall context in which speech was understood by self and others. Similarly, speech was differentiated into task-relevant and task-irrelevant, not on the basis of the content of speech, but its actual relatedness to the ongoing task. Finally, speech content was classified into various context-dependent pragmatic categories of speech that captured 'what was meant' rather than 'what was said'. Finally, the feature of 'sharedness of the goal' was adopted as the psychologically determining feature of the social context in which verbal mediation of behaviour was observed.

Hence by combining the temporally and contextually sensitive approach employed in the theoretical framework, classification of the observed data, and the novel data analysis technique, different processes involved in the verbal mediation of behaviour were revealed in the findings. *Verbal control* and *verbal commentary* were demonstrated as the two processes which operated in tandem

to carry out successful verbal mediation of goal-directed behaviour. Moreover, three diverse contextual functions of speech were derived in this study by applying the Contextual Model of Verbal Mediation to the specific goal-sharing context of the study. A novel approach of examining qualitative group differences in the levels of verbal mediation of behaviour was also adopted in this study, that were shown to be consistent across the classroom and the laboratory settings. Thus, these findings make a compelling case for private speech studies to expand their theoretical framework while examining the function of private speech, as well as employ a temporally and contextually sensitive methodology for observing the diverse functions of private speech vis-à-vis behaviour.

Finally, the findings of this study highlight the importance of strategically timed speech with a suitable content, which is supportive and adaptive in nature, in relation to verbal mediation of behaviour. These can have several implications for educational practices. Firstly, teaching practices can demonstrate the strategic use of speech during problem-solving, through transparent and intentions use of such verbal strategies. Secondly, activities and dialogic practices within the classroom can be designed to encourage successful and adaptive verbal mediation of behaviour, both for the self and for others. Finally, in cases that may require active intervention, identification of specific patterns of maladaptive or ineffective verbal strategies during verbal mediation of behaviour, as demonstrated by this study, can lead to a more tailored and targeted intervention.

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Appendix A

Checklist of Independent Learning Development (CHILD) 3–5

Name of child: _____ Teacher: _____

Date: _____ School/setting: _____

	Always	Usually	Sometimes	Never	Comment
Emotional					
1. Can speak about own and others behaviour and consequences					
2. Tackles new tasks confidently					
3. Can control attention and resist distraction					
4. Monitors progress and seeks help appropriately					
5. Persists in the face of difficulties					
Pro-Social					
1. Negotiates when and how to carry out tasks					
2. Can resolve social problems with peers					
3. Shares and takes turns independently					
4. Engages in independent cooperative activities with peers					
5. Is aware of feelings of others and helps and comforts					
Cognitive					
1. Is aware of own strengths and weaknesses					
2. Can speak about how they have done something or what they have learnt					
3. Can speak about future planned activities					
4. Can make reasoned choices and decisions					
5. Asks questions and suggests answers					
6. Uses previously taught strategies					
7. Adopts previously heard language for own purposes					
Motivational					
1. Finds own resources without adult help					
2. Develops own ways of carrying out tasks					
3. Initiates activities					
4. Plans own tasks, targets and goals					
5. Enjoys solving problems					

Other comments:

Appendix B

<u>Shapiro-Wilk tests for Normality</u>

1) Classroom dataset:

p<.05 : data deviates from normal distribution, highlighted in red

Variable	Statistic	df	Sig.
iCHANGE	0.983	8	0.974
iREPEAT	0.954	8	0.752
iROUTINE	0.947	8	0.683
iSEARCH	0.914	8	0.381
iCHECK	0.956	8	0.770
iNOTICE	0.905	8	0.320
iREGULATING	0.890	8	0.236
iGOAL	0.814	8	0.040
iFAILURE	0.955	8	0.761
iFAIL_STRATEGY	0.898	8	0.278
iDISTRACTION	0.931	8	0.522
iDISRUPTION	0.907	8	0.333
iFACILITATED	0.802	8	0.030
iREGULATED	0.916	8	0.400
iSEEK_HELP	0.768	8	0.013
iACTIVITY	0.765	8	0.012
iWANDER	0.832	8	0.062
iLEAVE_GOAL	0.522	8	0.000
iNEW_GOAL	0.936	8	0.571
iRETURGOAL	0.942	8	0.629
weCHANGE	0.690	8	0.002
weREPEAT	0.905	8	0.321
weROUTINE	0.639	8	0.000
weSEARCH	0.974	8	0.930
weCHECK	0.770	8	0.014

Variable	Statistic	df	Sig.
weNOTICE	0.871	8	0.155
weREGULATING	0.927	8	0.486
weGOAL	0.940	8	0.613
weFAILURE	0.820	8	0.046
weFAIL_STRATEGY	0.958	8	0.787
weDISTRACTION	0.912	8	0.365
weDISRUPTION	0.902	8	0.300
weFACILITATED	0.817	8	0.043
weREGULATED	0.459	8	0.000
weSEEK_HELP	0.879	8	0.184
weACTIVITY	0.956	8	0.776
weWANDER	0.950	8	0.710
weLEAVE_GOAL	0.759	8	0.010
weNEW_GOAL	0.710	8	0.003
weRETURN_GOAL	0.875	8	0.169
PRIVATE SPEECH_I_goal	0.701	8	0.002
PRIVATE SPEECH_we_goal	0.927	8	0.485
SOCIAL SPEECH _I_goal	0.770	8	0.014
SOCIAL SPEECH_we_goal	0.880	8	0.187

2) Laboratory dataset:

p<.05 : data deviates from normal distribution, highlighted in red

Variable	Statistic	df	Sig.
CHANGE	0.953	8	0.737
REPEAT	0.932	8	0.536
ROUTINE	0.865	8	0.134
SEARCH	0.855	8	0.108
CHECK	0.894	8	0.256
NOTICE	0.943	8	0.637
REGULATING	0.487	8	0.000
GOAL	0.929	8	0.510
GOAL_other	0.675	8	0.001
FAILURE	0.886	8	0.214
GOAL_NEGLECT	0.947	8	0.685
FAIL_STRATEGY	0.963	8	0.841
DISTRACTION	0.913	8	0.374
DISRUPTION	0.831	8	0.060
FACILITATED	0.824	8	0.051
REGULATED	0.819	8	0.046
SEEK_HELP	0.630	8	0.000
ACTIVITY	0.749	8	0.008
WANDER	0.418	8	0.000
LEAVE_GOAL	0.846	8	0.087
NEW_GOAL_solitary	0.875	8	0.170
NEW_GOAL_dyad	0.985	8	0.984
RETURN_GOAL_solitary	0.803	8	0.031
RETURN_GOAL_dyad	0.862	8	0.125
PRIVATE_SPEECH	0.856	8	0.110
SOCIAL_SPEECH	0.793	8	0.024

Appendix C

1) <u>Parental consent form: Classroom phase</u>

Faculty of Education

184 Hills Road, Cambridge CB2 8PQ

Dear Parent / Guardian

      The Head Teacher and the Reception Class Teacher at your child's school have accepted the invitation to participate in a research study concerned with young children's self-regulated learning in Nursery classrooms. I am particularly interested in finding out about the relationship between self-regulated behaviour and the audible self-directed talk that children use to communicate with themselves, as they go about their daily activities. I am conducting this project as part of my Ph.D. project under the supervision of Dr. David Whitebread, Senior Lecturer at the Faculty of Education, University of Cambridge.

      I am writing to ask for your written permission for your child to be involved in this study. In order to analyse the naturally occurring behaviour and self-directed talk that children engage in, I would like to video record the various activities that your child will be performing with the other children in the classroom, without obstructing their activities in any way.

      I can assure you of absolute confidentiality regarding your child's performance. The videotapes I make will only be seen by me and my supervisor and used for my research and for restricted educational purposes, such as for display in a research conference or a lecture. The videos will be anonymously coded, and the results will be presented in terms of groups rather than individuals. Even the name of the school will remain confidential and will not appear in any accounts of the work that are published. I can assure you that the daily activities of the children will not be disturbed by the observation and the videos will not be distributed anywhere, either physically or online. However, if either you or your child wishes to withdraw from the study at any point, this will be adhered to without question.

      If you are willing for your child to participate, we would be grateful if you could sign and return the permission slip below to your child's class teacher. If you would like more information about the project, please do get in touch with me by email or phone.

Yours sincerely

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Tel: 07432687358

Dr. David Whitebread
Senior Lecturer in Psychology & Education
Faculty of Education,
University of Cambridge

Self-Talk Project   Date _____

I give / do not give (please delete as appropriate) permission for my child

_____ (child's name) to participate in this research project.

Signed _____ (parent / guardian)

2) <u>Parental consent form: Laboratory phase</u>

Faculty of Education

UNIVERSITY OF CAMBRIDGE

184 Hills Road, Cambridge CB2 8PQ

Dear Parent or Guardian

     Thank you for co-operating with us in the Self-Talk Project so far. As mentioned before, we are investigating the relationship between the language that children use and its effect on their ability to 'self-regulate', i.e. carry out self-initiated, goal-directed activities in a planned yet flexible manner. For this purpose, with the help of the teachers, we have chosen some of the children who exhibit highly self-regulated behaviour in the classroom. Your child is one of the eight children selected from the class.

     The first phase of the project involves video-recording the daily classroom activities of the selected children. Over a period of three weeks, approximately one hour of video will be collected per child.

     The second phase of this project involves inviting the selected children to visit the Faculty of Education in groups of two or three, along with their parents, for a single play-session in our child-observation facility. The session will last for an hour and a half, wherein the children will play with Lego® toys provided by the Faculty. The parents will be seated in the same area, but behind a one-way mirror, such that they will be able to see their child at all times.

     I am writing to ask whether you will be willing to bring your child to the Faculty of Education for a day, after school-hours. The date and time of the play-session can be mutually agreed upon between you and the parents of another child involved in the study. We will be able to hold this session either on weekdays after school, or on weekends or during school holidays. The sessions will last for approximately 1 and a half hour, with breaks in between.

     I can again assure you of absolute confidentiality regarding your child's performance and the use of the videotapes only for research purposes and for restricted educational purposes, such as for display in a conference or a lecture. However, if either you or your child wishes to withdraw from the study at any point, this will be adhered to without question.

     If you are willing for to bring your child to the Faculty of Education, we would be grateful if you could sign and return the confirmation slip below to your child's class teacher. If you would like more information about the project, do inform the class teacher and I would be most pleased to get in touch with you.

Yours sincerely

Ms. Mohini Verma
PhD candidate, Psychology & Education
Faculty of Education,
University of Cambridge
Email: mv318@cam.ac.uk
Tel: 07432687358

Dr. David Whitebread
Senior Lecturer in Psychology & Education
Faculty of Education,
University of Cambridge
& Governor of Homerton Children's Centre

Self-Talk Project   Date _____

I confirm / do not confirm (please delete as appropriate) that I will be able to bring my child

_____ (child's name) to the Faculty of Education for the play session.

Signed _____ (parent or guardian)

Contact No. _____ Email: _____

Appendix D

Speech codes in 'context-based speech' & 'pretence speech'

Table 1. Individual speech codes under the categories 'context-based speech' and 'pretence speech', with description and examples observed in the recorded data, all coded as discrete point events. These 29 codes have been classified under the nine pragmatic categories of speech

Category	Description	Example
(A) Context-based speech:		
1) directing/ stating a rule	An utterance getting someone else to do something through a command, advice, recommendation, order or suggestion; reminding or declaring a working rule of the activity which people should follow, may or may not be directed to any one in particular	*"You have to put this over there first"* *"Don't touch"* *"Why don't you give it a try"* *"We need to share"*
2) proposing a plan	Future-oriented statement about one's own action or one's action as a group, through a plan, proposal or promise	*"I'm going to play in the water"* *"First I need some.."* *"We can cover it up with straws"*
3) instrumental	An utterance asking someone to do something specifically for the speaker or to give something to the speaker, by requesting, seeking permission, expressing wants; whining; demanding; begging. The utterance can be in the form of a statement or a question.	*"Can I have some more?"* *"I want a spoon"* *"Can I dry your hair?"* *"It's my turn now"* *"Wait for me please"*
4) describing one's actions	An utterance describing or reporting one's own on-going or just completed actions, even though the form of utterance may be future-oriented, or expressing a desire, while carrying out the described action.	*"I have to put these cookies back"* <saying while putting the cookies back> *"I need lots of tape"* <while taking tape out of the tape dispenser> *"I've built three shapes"*
5) referential	Perceptual or conceptual description of an object or event present within the on-going activity, but does not refer to the speaker's own action (as in *describing one's actions)*. The utterance does not involve an evaluation of the object/event being referred to, from the perspective of goal-attainment (as in *evaluation*).	*"it's stuck in there"* *"one, two, three, four"* (counting the objects in front of her) *"There's another cookie"* *"It's too wet!"*

6) evaluative	An utterance evaluating or assessing the difficulty, progress or accuracy of the on-going task, or evaluating the suitability of an object/event/action in solving the task; recognising or declaring the attainment of one's goal	*"Not easy…hard"* *"We're doing a good job"* *"Oh no this...this one can't fit"* *"I'm done"*
7) consequential	An utterance describing consequential or conditional reasoning, usually using phrases such as 'if-then', 'hence', 'that is why', 'coz', 'so that', etc.	*"Then it all gonna stay [..]"* *"Coz they, coz they go in the family"* *"One here to make it stable"*
8) metacognitive self-knowledge	An utterance expressing one's own knowledge and/or understanding of one's own abilities or cognitive processes such as memory, attention, etc.	*"I can't do all of it"* *"Yes, we know that already"* *"I just thought of what to do"*
9) expressive	An utterance expressing one's feelings, opinions, surprise, disappointment, complaint; an utterance thanking, congratulating, apologizing or complementing someone - in the form of words or exclamatory expressions	*"Yay, I love that!"* *"You are not my friend anymore!"* *"That's not fair!"* *"Arrgh"* <when something falls down> *"Oops, I'm sorry"* *"Oh"; "Woohoo"*
10) laughing/ crying/ screaming	Outbursts of emotional expression in the form of laughing, crying, screaming, etc. If an utterance is spoken in one of these forms, but has a clear semantic content which can be identified as another code, then utterance is preferentially categorised as that code.	<laughing after a tower of wooden bricks falls down> <screaming at another child after he has snatched a toy>
11) seek information	W-h questions, asking for a particular information, opinion or confirmation, which was hitherto unknown to the speaker; not simply a rhetorical question in the syntactical form of a question but intended as a *directing/ stating a rule* statement (e.g. - "Will you tidy-up now?") or an *instrumental* statement (e.g. - "Isn't it my turn now?")	*"Where did it go?"* *"Will you have it later?"* *"How old are you?"* *This is yours?"* *"Are you sure you don't want more?"*

12) response	An utterance providing some specific information or confirmation as a response to a previous *seek information*; a reply to a yes/no question (where yes/ no is a new information, not an agreement or a disagreement).	*"In that box"* < in response to "Where does this go?"> *"No, not mine"* < in response to "Is this yours?">
13) agreement	An utterance agreeing to a previous utterance or action.	*"Yeah, of course we can"*
14) disagreement	an utterance disagreeing to a previous utterance or action.	*"No, its not ready yet"*
15) repeating oneself	Fully or partially repeating oneself, for the same situation, not applicable when the same statement is made but for a different situation.	*"you need a shower"* <previous utterance addressed to another child - "you need a shower now", followed by a repeated utterance, spoken in a lowered volume>
16) repeating other	Fully or partially repeating a part of the speech by the previous speaker.	*"stop"* <previous speaker stopped another child by saying - "stop!", child repeats the utterance in a lowered volume to herself>
17) transitional	Words accompanying a change or transit from one action to another; filler words between two actions	*"All right then"* *"There"* <after finishing one action and moving on to another> *"And...and"*
18) attentional	Calling out to someone to seek attention or direct their attention to something; usually be followed by other speech categories, once listener's attention has been directed to the desired object.	*"Look, I got a gem!"*; *"Ted, here you go"*
19) unclear / unrecordable	Abbreviated or incomplete utterance which could not be understood in the given context; an utterance which could not be heard due to technical limitations, noise, etc.	*"[…] up in all in"* *"Its […] "*
20) muted speech/ mumbling	Lip movements or mumbling without external and loud speech	<lips moving>
21) singing/ humming/ word play	Singing along, humming a tune, uttering nonsense words	<singing along with the 'tidy-up' song being played in the classroom>
22) non-present speech	Describing non-present objects/events in distant past or future	*"It's my birthday tomorrow"* *"Do you like spiders"?* *"Our teacher is funny, isn't she?"*

(B) Pretence speech:		
23) enactment	An utterance spoken within the pretend frame, while enacting a role; tone of voice, gestures and body language indicate role transformation; it occurs when all other roles and meanings have been established in the pretend framework; the utterance does not add anything new to the script by way of extending it	*"Fishy, gotch ya, come on fishy, come on"* *"Oh my goodness!"* *"Mummy, I'm hungry…I'm hungry"*
24) ulterior conversation	An utterance spoken within the pretend frame, while enacting a role, but its ulterior purpose is to create and manage the pretence scenario; purpose is achieved through proposing new elements to the script, asking questions with implicit answers that develop the plot, reporting the addition of a new character or object, announcing personal or collective future action, etc.	*"But, but, but they don't have any food"* *"Is that a bit hot?"* *"Come on, meet my darling"* *"Let's have a packed lunch"*
25) underscoring	An utterance spoken out of the pretend frame, to describe actions, objects, characters or settings that verbally indicate how the non-verbal behaviour within the pretend framework should be interpreted. Usually involves sound-effects, chanting or using magic words which stand for the on-going action.	*"Some pepper..some sprinkles"* <while placing some props inside a lunch box> *"Argh"* <while lifting the box, pretending it to be heavy> *"Wiggle woggle, wiggle woggle"* <while tossing around a 'pancake' in the frying-pan>
26) storytelling	An utterance spoken in the narrative style, usually in the past tense, like a storyteller (hence not enacting a role within the pretend frame), to provide history or lay out the plot without acting it all out.	*"Then I said yes, you will have one, one of the cookies…"* *"He got blood in his ears, so they had to put, they had to.."*
27) prompting	An utterance that suddenly breaks out of the pretend frame to clarify the characteristics of objects and roles and prompt other players to give appropriate responses; usually involves short commands or reminders, after which action is resumed in the pretend frame	*"But you're the hairdresser!"* <reminding the child playing the the 'hairdresser', who forgot her role and said: "we'll have to go to the hairdressers to [...] your hair"> *"Green iguana"* <reminding the other child, the identity of the toy they were playing with, when she said: "Where's the koala?">

28) implicit pretend structuring	An utterance that is out of the pretend frame, and involves making suggestions about actions and roles while leaving the proposal of "pretend" implicit; usually involves assigning and negotiating roles and rules, accepting proposals, requesting and inviting to join the play, etc.	"Let's make another dinner" <proposing to continue the game of 'making dinner for daddy'> "And I'm a dad" <negotiating with others to play the role of the 'dad'> "Do you want to help us find some fish?" <inviting a child standing nearby to join the game>
29) explicit proposal	An utterance that is out of the pretend frame while making a formal and explicit proposal or acknowledgement of pretence; usually involves proposals to pretend at the start of the game, to establish roles, transform objects and settings, set explicit plans or terminations, etc.	"Ooh Tony, I'm playing" <overtly reminding the other child that 'its just pretend', when he gets upset over an action during the game> "Let's pretend this is a pirate ship" <transforming the sand table to a 'pirate ship' explicitly>

Appendix E
Spearman's rank correlation coefficients

A) Private speech:

								Goal-related behaviours (N = 8)												
	CHANGE	REPEAT	ROUTINE	SEARCH	CHECK	NOTICE	REGULATE	ATTAIN_G	FAIL_G	FAIL_STR	DISTRAC	DISRUPT	FACILITATE	REGULAT-ED	SEEK HELP	FOCUS_A	WANDER	LEAVE_G	NEW_G	RE-TURN_G
Soc I_goal	-0.500	-0.371	-0.190	-0.071	-0.476	-0.405	0.167	0.476	-0.084	-0.310	0.143	-.838**	-0.119	-0.548	0.152	0.190	-0.146	-0.120	0.381	-0.635
Soc we_goal	0.643	-0.323	0.571	0.476	0.619	.786*	-0.024	0.214	0.048	0.167	0.024	-0.143	0.452	0.078	0.286	0.048	-0.524	0.228	0.095	-0.452

● * - p value <.05; ** - p value <.01

● CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; AT-TAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

B) Social speech:

								Goal-related behaviours (N = 8)												
	CHANGE	REPEAT	ROUTINE	SEARCH	CHECK	NOTICE	REGULATE	ATTAIN_G	FAIL_G	FAIL_STR	DISTRAC	DISRUPT	FACILITATE	REGULAT-ED	SEEK HELP	FOCUS_A	WANDER	LEAVE_G	NEW_G	RE-TURN_G
Private I_goal	-0.143	0.132	-0.024	0.548	0.381	-0.071	-.786*	-.976**	0.228	-0.238	-0.381	0.335	0.333	0.214	0.152	-0.548	0.098	0.383	-.857**	0.419
Private we_goal	-0.643	0.048	-0.476	-0.143	0.167	-0.429	0.120	0.476	0.190	0.000	0.190	-0.071	-0.333	-0.546	0.071	0.095	0.024	0.611	-.857**	-0.048

● * - p value <.05; ** - p value <.01

● CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; AT-TAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

Appendix F
Comparison of Spearman's correlation coefficients (rho values) using back-transformed Fisher's Z procedure

A) Private speech:

Goal-related behaviours (N = 8)																				
Rho_I vs Rho_we	CHANGE	REPEAT	ROUTINE	SEARCH	CHECK	NOTICE	REGULATE	ATTAIN_G	FAIL_G	FAIL_STR	DISTRAC	DISRUPT	FACILITATE	REGULATED	SEEK HELP	FOCUS_A	WANDER	LEAVE_G	NEW_G	RETURN_G
z =	**-2.21**	.086 p	-1.38	.928 p	-1.91 p	**-2.41**	.302	.454	.201 p	.753 p	.188	-1.71 p	-1.02 p	-1.11 p	.222 p	.232	.574	.477 p	.486	.425 p
p =	**.020**	.931	.165	.353	.056	**.0156**	.762	.649	.840	.451	.850	.087	.307	.266	.823	.816	.565	.633	.626	.670

- **Rho_I** = Spearman's correlation coefficient between speech and goal-related behavior in I_goal; **Rho_we** = Spearman's correlation coefficient between speech and goal-related behavior in we_goal
- (significant differences between correlation coefficients in red)
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

B) Social speech:

Goal-related behaviours (N = 8)																				
Rho_I vs Rho_we	CHANGE	REPEAT	ROUTINE	SEARCH	CHECK	NOTICE	REGULATE	ATTAIN_G	FAIL_G	FAIL_STR	DISTRAC	DISRUPT	FACILITATE	REGULATED	SEEK HELP	FOCUS_A	WANDER	LEAVE_G	NEW_G	RETURN_G
z =	.964	.134	.856	1.275 p	.358	.680	-1.86 p	**-3.56**	.074	-.39	.820 p	.860 p	1.083 p	1.199 p	.125	-1.23 p	.121	-.478	.000 p	.789
p =	.335	.893	.391	.202	.719	.493	.061	**.0004**	.940	.689	.412	.389	.278	.230	.900	.216	.903	.632	1.00	.430

- **Rho_I** = Spearman's correlation coefficient between speech and goal-related behavior in I_goal; **Rho_we** = Spearman's correlation coefficient between speech and goal-related behavior in we_goal
- (significant differences between correlation coefficients in red)
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

Appendix G

Spearman's rank correlation coefficients between speech & behaviour

1) Ps_I_goal condition:

Table 1. Spearman's rank correlation coefficients between Rpm (rate per minute) occurrences of goal-related behaviors and nine pragmatic categories of private speech, as well as overall private speech in the I_goal context (ps_I_goal)

Goal-related behaviours	Pragmatic private speech categories									
	directive	informative	evaluative	emotive	seek/respond	agree/disagree	repetitive	indistinct speech	other speech	overall private
CHANGE	.097	.340**	.302*	.349**	.195	.057	.100	.234	.208	.486**
REPEAT	.137	.110	.314*	.027	.379**	.164	.154	.289*	.076	.283*
ROUTINE	.143	.144	.162	.315*	.044	.083	.079	.434**	.024	.467**
SEARCH	.152	.387**	.278*	.143	.351**	.082	.226	.438**	-.031	.468**
CHECK	.274*	.253*	.375**	.419**	.234	.069	.324**	.416**	.196	.484**
NOTICE	.164	.246	.015	.204	.111	.122	.186	.411**	.280*	.447**
REGULATE	.184	.256*	.040	.170	-.076	.206	.156	.215	.184	.099
ATTAIN_G	.108	.024	-.033	.029	.113	.029	.024	.091	-.010	.172
FAIL_G	.174	.180	.229	.103	.004	.173	.113	.139	.008	.087
FAIL_STR	.149	.292*	.202	.168	.229	.089	.222	.200	.130	.372**
DISTRAC	.233	.199	.301*	.276*	.071	.092	.206	.459**	.338**	.439**
DISRUPT	.327**	.293*	.202	.459**	.237	.123	.301*	.265*	.201	.435**
FACILITATE	.310*	.228	.059	.096	.075	.110	.260*	.255*	.165	.283*
REGULATED	.291*	.345**	-.038	.238	-.090	.219	.290*	.500**	.113	.364**
SEEK HELP	.037	.133	.095	-.034	.107	.045	.076	-.080	.005	.056
FOCUS_A	.384**	.412**	.323**	.121	.184	.134	.161	.203	.143	.302*
WANDER	.215	.435**	.122	.003	-.044	.173	.064	.238	.319*	.317*
LEAVE_G	.138	.272*	.060	.122	.013	.082	.188	.387**	.206	.343**
NEW_G	-.065	-.073	-.142	-.012	-.005	.091	-.058	.001	.004	.110
RETURN_G	.199	.429**	.128	.141	-.009	.168	.343**	.324**	.180	.379**

- *** - p value <.05; ** - p value <.01**
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

2) Ps_we_goal condition:

Table 2. Spearman's rank correlation coefficients between Rpm (rate per minute) occurrences of goal-related behaviors and nine pragmatic categories of private speech, as well as overall private speech in the we_goal context (ps_we_goal)

Goal-related behaviours	Pragmatic private speech categories									
	directive	informative	evaluative	emotive	seek/respond	agree/disagree	repetitive	indistinct speech	other speech	overall private
CHANGE	.398**	.453**	.161	.326**	.059	.000	.213	.363**	.193	.532**
REPEAT	.245	.181	.254*	.357**	-.070	.000	.187	.169	.172	0.226
ROUTINE	.325**	.412**	.213	.259*	-.134	.000	.181	.296*	.172	.403**
SEARCH	.187	.391**	.248*	.268*	.245	.000	.194	.347**	.359**	.550**
CHECK	.340**	.182	.250*	.180	.114	.000	.137	.139	.037	.263*
NOTICE	.212	.418**	.064	.118	.202	.000	.187	.336**	.195	.412**
REGULATE	.257*	.493**	.060	.074	-.079	.000	-.079	.316*	.268*	.408**
ATTAIN_G	.133	.098	.147	.032	.226	.000	.030	-.008	.151	0.161
FAIL_G	.098	.006	-.087	-.023	-.061	.000	-.061	.283*	.126	0.183
FAIL_STR	.155	.188	.198	.251*	.123	.000	.092	.353**	.228	.355**
DISTRAC	.293*	.470**	.061	.317*	-.082	.000	.241	.379**	.485**	.414**
DISRUPT	.445**	.291*	.203	.468**	-.082	.000	.189	.423**	.275*	.498**
FACILITATE	.245	.315*	.289*	.186	-.082	.000	.155	.326**	.282*	.390**
REGULATED	.448**	.471**	-.129	.225	-.090	.000	.238	.522**	.352**	.551**
SEEK HELP	.172	-.112	-.033	-.053	-.023	.000	-.023	.283*	.185	0.188
FOCUS_A	.384**	.434**	.186	.292*	-.061	.000	.224	.275*	.143	.433**
WANDER	.301*	.332**	.148	.179	-.052	.000	.287*	.156	.365**	.307*
LEAVE_G	.229	.303*	.026	.113	-.085	.000	.144	.227	.293*	.275*
NEW_G	.066	.129	.031	.046	.178	.000	.107	.138	.037	0.246
RETURN_G	.195	.360**	.184	.411**	-.082	.000	.181	.259*	.297*	.386**

- *** - p value <.05**; **** - p value <.01**
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

3) Soc_I_goal condition:

Table 3. Spearman's rank correlation coefficients between Rpm (rate per minute) occurrences of goal-related behaviors and nine pragmatic categories of social speech, as well as overall social speech in the I_goal context (soc_I_goal)

Goal-related behaviours	Pragmatic social speech categories									
	directive	informative	evaluative	emotive	seek/respond	agree/disagree	repetitive	indistinct speech	other speech	overall social
CHANGE	.119	.233	.006	.044	-0.182	.099	.021	0.093	-.017	0.019
REPEAT	.249*	.251*	.278*	.093	-0.024	.304*	.121	0.068	.199	0.216
ROUTINE	.123	.324*	-.018	.127	-0.118	.132	.177	0.195	.033	0.122
SEARCH	.206	.205	-.020	.129	0.032	.047	.145	.406**	.050	0.089
CHECK	.277*	.264*	.134	.120	-0.142	.164	.238	.120	.161	0.118
NOTICE	.138	.142	-.110	-.043	-0.139	.173	.097	.409**	.067	0.024
REGULATE	.668**	.357**	.119	.219	0.034	.525**	.131	.208	.049	.378**
ATTAIN_G	.346**	.316*	.281*	.202	0.145	.345**	.122	.197	.162	.467**
FAIL_G	.421**	.370**	.167	.361**	0.130	.336**	.304*	.085	.023	.356**
FAIL_STR	.304*	.407**	.111	.224	-0.067	.295*	.228	.258*	-0.101	.258*
DISTRAC	.072	.058	.019	.194	-0.069	.020	.020	.029	.004	-0.044
DISRUPT	.190	.177	-.091	.068	-0.106	.162	.077	.110	.120	0.057
FACILITATE	.407**	.350**	.246	.233	0.172	.464**	.220	.651**	.017	.361**
REGULATED	.405**	.323**	.089	.318*	0.077	.433**	.286*	.501**	-0.023	.356**
SEEK HELP	.208	.125	.210	.376**	.308*	.234	.267*	.194	.276*	.344**
FOCUS_A	.458**	.374**	.464**	.192	0.151	.158	.032	.174	.065	.342**
WANDER	.125	.303*	-.171	.059	-0.135	.148	.287*	.436**	-0.031	0.108
LEAVE_G	.252*	.197	-.077	.098	-0.127	.241	.186	.185	.162	0.145
NEW_G	.242	.299*	.084	.159	0.117	.235	.238	.087	.117	.490**
RETURN_G	.265*	.149	.075	.329**	0.009	.112	.045	.193	.205	0.065

- *** - p value <.05**; **** - p value <.01**
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

4) Soc_we_goal condition:

Table 4. Spearman's rank correlation coefficients between Rpm (rate per minute) occurrences of goal-related behaviors and nine pragmatic categories of social speech, as well as overall social speech in the we_goal context (soc_we_goal)

Goal-related behaviours	Pragmatic social speech categories									
	directive	informative	evaluative	emotive	seek/respond	agree/disagree	repetitive	indistinct speech	other speech	overall social
CHANGE	.437**	.360**	.501**	.471**	.260*	.415**	.115	.252*	.262*	.587**
REPEAT	.407**	.292*	.378**	.276*	.119	.265*	.300*	.286*	.259*	.483**
ROUTINE	.410**	.463**	.401**	.339**	.160	.315*	.153	.108	.268*	.538**
SEARCH	.335**	.601**	.173	.272*	.261*	.380**	.124	.344**	.343**	.467**
CHECK	.498**	.212	.500**	.243	.210	.216	.186	.128	.214	.494**
NOTICE	.523**	.442**	.395**	.430**	.182	.408**	.097	.225	.220	.550**
REGULATE	.648**	.394**	.181	.273*	.320*	.364**	.026	.256	.247	.510**
ATTAIN_G	.498**	.325**	.261*	.268*	.360**	.265*	.154	.252*	.142	.539**
FAIL_G	.194	.212	.140	-.141	.040	.032	.269*	.117	.079	0.229
FAIL_STR	.302*	.334**	.472**	.369**	.030	.233	.138	.180	.263*	.430**
DISTRAC	.347**	.364**	.427**	.340**	-.031	.462**	.223	.271*	.399**	.331**
DISRUPT	.319*	.210	.651**	.191	.041	.126	-.006	.161	.381**	.285*
FACILITATE	.417**	.368**	.305*	.160	.125	.221	.367**	.335**	.110	.372**
REGULATED	.525**	.552**	.209	440**	.446**	.422**	.303*	.306*	.328**	.554**
SEEK HELP	.185	-.075	.353**	-.087	-.078	-.125	-.059	-0.087	.312*	0.016
FOCUS_A	.350**	.290*	.373**	.431**	.212	.361**	.240	.212	.372**	.345**
WANDER	.279*	.374**	.080	.142	-.047	.343**	.459**	.242	.429**	.315*
LEAVE_G	.299*	.474**	.293*	.179	.104	.223	.323**	.101	.322**	.382**
NEW_G	.472**	.433**	.273*	.156	.273*	.280*	.141	.217	.080	.684**
RETURN_G	.159	.487**	.347**	.329**	.048	.417**	.278*	.238	.384**	.449**

- *** - p value <.05; ** - p value <.01**
- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

Appendix H

Co-occurrences of speech & behaviour through robust t-pattern search

1) Ps_I_goal condition:

Table 1. Co-occurrences of goal-related behaviors with the nine pragmatic categories of private speech in t-patterns within the I_goal context (ps_I_goal). The number in parentheses below each pragmatic category indicates the number of unique t-patterns in which the category appears with behaviour.

Goal-related behaviours	Pragmatic private speech categories								
	directive (1)	informative (4)	evaluative	emotive	seek/ respond	agree/ disagree	repetitive	indistinct (10)	other
CHANGE		▓						▓	
REPEAT									
ROUTINE	▓							▓	
SEARCH									
CHECK								▓	
NOTICE									
REGULATE									
ATTAIN_G									
FAIL_G									
FAIL_STR									
DISTRAC									
DISRUPT									
FACILITATE									
REGULATED									
SEEK HELP									
FOCUS_A									
WANDER									
LEAVE_G									
NEW_G		▓						▓	
RETURN_G									

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

▓ present in a t-pattern

2) Ps_we_goal condition:

Table 2. Co-occurrences of goal-related behaviors with the nine pragmatic categories of private speech in t-patterns within the we_goal context (ps_we_goal). The number in parentheses below each pragmatic category indicates the number of unique t-patterns in which the category appears with behaviour.

Goal-related behaviours	Pragmatic private speech categories								
	directive	informative (13)	evaluative	emotive	seek/ respond	agree/ disagree	repetitive	indistinct (7)	other (8)
CHANGE		▮						▮	
REPEAT									
ROUTINE		▮							▮
SEARCH									
CHECK									
NOTICE		▮							▮
REGULATE									
ATTAIN_G									
FAIL_G									
FAIL_STR									
DISTRAC									
DISRUPT								▮	
FACILITATE									
REGULATED									
SEEK HELP									
FOCUS_A									
WANDER									
LEAVE_G									
NEW_G									
RETURN_G									

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

▮ **present in a t-pattern**

3) Soc_I_goal condition:

Table 3. Co-occurrences of goal-related behaviors with the nine pragmatic categories of social speech in t-patterns within the I_goal context (soc_I_goal). The number in parentheses below each pragmatic category indicates the number of unique t-patterns in which the category appears with behaviour.

Goal-related behaviours	**Pragmatic social speech categories**								
	directive	informative	evaluative	emotive	seek/ respond	agree/ disagree	repetitive	indistinct speech	other speech
CHANGE	▉	▉							
REPEAT									
ROUTINE	▉							▉	
SEARCH									
CHECK								▉	
NOTICE	▉	▉							
REGULATE	▉	▉							
ATTAIN_G	▉	▉				▉		▉	
FAIL_G									
FAIL_STR	▉	▉							
DISTRAC									
DISRUPT									
FACILITATE	▉							▉	
REGULATED	▉	▉							
SEEK HELP									
FOCUS_A	▉								
WANDER									
LEAVE_G	▉								
NEW_G		▉				▉		▉	
RETURN_G									

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

▉ present in a t-pattern

XX

4) Soc_we_goal condition:

Table 4. Co-occurrences of goal-related behaviors with the nine pragmatic categories of social speech in t-patterns within the we_goal context (soc_we_goal). The number in parentheses below each pragmatic category indicates the number of unique t-patterns in which the category appears with behaviour.

Pragmatic social speech categories

Goal-related behaviours	directive (106)	informative (160)	evaluative (5)	emotive	seek/ respond	agree/ disagree (11)	repetitive	indistinct speech (72)	other speech
CHANGE	■	■	■			■		■	
REPEAT									
ROUTINE	■	■	■			■		■	
SEARCH		■						■	
CHECK	■	■							
NOTICE	■	■							
REGULATE	■	■							
ATTAIN_G	■	■							
FAIL_G									
FAIL_STR	■							■	
DISTRAC									
DISRUPT		■	■					■	
FACILITATE									
REGULATED	■	■							
SEEK HELP									
FOCUS_A									
WANDER									
LEAVE_G									
NEW_G	■	■							
RETURN_G		■							

- CHANGE = change strategy; REPEAT = repeat failed strategy; ROUTINE=routine strategy; SEARCH=search strategy; CHECK=check progress; NOTICE=notice error/issue; REGULATE=regulate other; ATTAIN_G=goal attained; FAIL_G=failure to attain goal; FAIL_STR=failed strategy; DISTRACT=distraction; DISRUPT=disruption; FACILITATE=facilitative event; REGULATED=regulated by others; SEEK HELP=seek help; FOCUS_A=start focused activity; WANDER=start wandering behaviour; LEAVE_G=leave goal pursuit; NEW_G=new goal pursuit; RETURN_G=return to previous goal

■   present in a t-pattern