The word ‘collaborating’ suggests people acting in a positive manner. One that is quite natural and uncomplicated. So, the most routine of conversational exchanges may be approvingly termed “collaborative”. Such as deciding the best place to meet. Or discussing a possible gift for a friend. However, when distinguishing and categorising different acts of learning, the word ‘collaborating’ is troublesome. The problem is that too many interestingly different learning practices can become blurred together by this same umbrella term. Take the following chapters of the present book for instance. They each refer to learning activities for which the description ‘collaborating’ would often – if not always - apply. So, a student and teacher in a *tutoring* session could be said to be collaborating. Even attending the *exposition* of a lecture can require collaborating (rules of social order get requested and respected). Nevertheless, it has to be admitted that those different learning practices do still have a common feature at their core. Perhaps the best way of expressing this is simply to say that they each involve people convened for ‘*thinking together’*.

1. **Introduction**

The fact that thinking together features within many acts of learning will be repeatedly illustrated in this book. However, the present chapter concerns those learning circumstances where thinking together is the focal thing, where it is the very engine of what is being done. These are situations where students (or their teachers) might say: “Let’s collaborate to understand this” or “Lets collaborate to get this built”. And they are situations where we suppose participation then promises learning. It is in the spirit of an ‘acts of learning’ approach, to discuss ‘collaborating’ by reference to its *verb* form, as something that we *do*. But understanding it will be greatly helped by noting also its noun and adjective forms. These offer two further windows onto the same topic. So, when we consider ‘*the* collaboration’ (noun), we will be considering matters of educational design: how to best create a learning episode involving peers thinking together. When we consider ‘collaborative person’ (adjective), we will be acknowledging a psychological disposition - a particular orientation towards shared thinking.

First, the noun: *the collaboration* as a design for interacting with others. If you and I discuss a possible gift for a friend, we are “interacting with others” but we would probably not call that “a collaboration”. Doing so would elevate a casual conversation – albeit goal-oriented – into something more formal. Something more like the thinking-together episodes orchestrated in classrooms or workplaces. In fact, the very episodes that will be of particular interest to this chapter. Those imply a kind of contract, one in which students (or colleagues) sign up for something rather like the following: partners are gathered with roughly matched expertise, a shared problem is defined, a time window is set for the activity, there is a commitment to democratic interaction, and then a striving for closure – ideally with consensus and perhaps with an expectation of evaluation by outside actors (teachers or managers). It sounds a good script for solving problems. Moreover, joining in may be a good way to stimulate learning. Across this chapter, we term such problem-solving contracts ‘*schooled* collaborations’. Not that they are unique to schooling, but school is where such formal collaboration episodes are usually first cultivated and it is probably where we acquire an understanding of shared problem-solving that stays with us.

Second, the verb: *collaborating*. When it is considered as an act of learning, it is the ‘democratic interaction’ that takes place within a (schooled) collaboration. Psychological research on this topic involves exposing, systematising and understanding what happens between people during such interactions. As an occasion for learning, the success of a collaboration is best understood by exploring exactly how partners talked and acted together. From this it becomes possible to recognise how practices for productive interaction evolve with experience and how certain features of those practices predict learning outcomes for those who take part.

Finally, the adjective: *collaborative*. If research does identify such strategies for productive interaction, then ‘collaborative’ describes individuals who regularly employ them. Pointing the research lens in that direction may inform a more wider-ranging sense of ‘collaborating’ as an act of learning. That is, a sense of how experience gained in the structure of schooled collaborations can percolate up and guide the flow of *any* informal thinking together with others. Considering the adjective form allows us to recognise individuals or groups adopting a ‘collaborative approach’ to *whatever* everyday interactions have potential for learning. In short, acting collaboratively is a disposition that individuals may bring to a range of learning situations – not just those problem-solving interactions that we formally label ‘collaborations’.

The plan for addressing these grammatical distinctions here is as follows. The next section sketches three examples of schooled collaborations to illustrate common methods of both practice and research. Section 3 considers research that explores their efficacy for learning. Schooled collaborations have generally been found to be effective for learning, but not always so. The reasons for varying outcomes are then explored. Four features of collaborative discussion associated with success are reviewed. Section 4 considers three ways in which collaborations can be structured to be more effective. Section 5 explores the underpinning of shared thinking through the model of a ‘collaborating mind’. This section is important for indicating why some collaborations can fail to support the learning of their participants. The final section evaluates the credibility of claims for a basic human disposition to collaborate.

**2. The collaboration: designing for shared thinking**

The present section outlines three concrete examples for ‘the collaboration’ (noun) as introduced above: short episodes of thinking together around some problem but conceived to support the learning of those taking part. These examples come from published reports and so they illustrate key research methods as well as the wide range of topics suited to a classroom collaboration. In the present examples, those topics are mathematical physics, historical interpretation, and building a material object. Because so much educational psychology research around collaborating has focussed on episodes of this kind, the following examples may serve as reference points for interpreting and judging the various research outcomes summarised in this chapter.

The first case (A) clearly addresses whether a collaboration has influenced the learning of those who took part. This requires comparing the learning outcome for individuals who studied some topic by themselves (‘solo’) with the outcome of (different but matched) individuals who each studied it in a collaborating pair/group. Chi and Menekse (2015) describe an example for university physics:

The two conditions were 10 pairs of undergraduate partners solving kinematics problems with a text and 10 solo undergraduates solving the same problems with the same text. The participants had to learn the first four chapters of the text and the conceptual part of the fifth chapter to a criterion. Then they were given a pretest that assessed their understanding of nine concepts related to kinematics. After the pretest, they were randomly assigned either to solve three problems taken from the fifth chapter with a partner or to solve the three problems alone. Finally, they took a post-test that was identical to the pretest. (p. 258-259)

This is just one study of collaborative learning. What happens across the range of such studies is considered in 3.1 below (as for this example – greater learning gains occurred on the post-test for those who were assigned to collaborate). In that widely-employed research design, collaboration is evaluated as an educational *method*: it is compared with working solo. The research question then concerns how effectively the collaborative method stimulates learning for those who take part. Findings from such research will be discussed in Section 3 below.

However, there is a second prominent research design: one that centres on the *performance* of collaborating. Here research questions grapple with the very nature of thinking together: asking how the mental efforts of individuals achieve coherence, integration and direction when placed in collaboration. After all, this is a way of interacting that has to be grown into. It differs from solving problems together in the playground. When collaborating in classrooms, the problems tackled are typically imposed, partners may not be those preferred, the place and duration of the interaction are constrained, a democratic attitude to participation is expected, and there may be a responsibility to report what was found and then have it evaluated. Research can document how willingly participants engage with such arrangements and what strategies they adopt when doing so. These matters are readily studied, because collaborators must make their thinking shared and public – including to researchers who can look on and report it.

In this second example, (B), Pontecorvo and Giradet (1993) make observations while 30 9-year-old students worked to achieve agreement around an historical narrative.

Children were asked to discuss together and reach a shared judgment about the interpretative description that Ammiano Marcellino (a Roman historian of the 4th century) gave of the Huns … The task was preceded by curriculum activities (guided by the teacher and lasting for about 10 hr of lesson time) involving the critical reading of historical documents concerning German populations in their relations with the Roman Empire … The children were asked to reach a consensus on: (a) what the historian meant by "habits similar to beasts…" (368-369) [Further such thinking targets were listed after this one]

So, these researchers analysed the students’ discourse to explore how an interpretative argument about historical events was performed by them. This record therefore reveals how the demand of a curriculum task stimulates students’ reasoning about that topic. The students’ autonomous discourse was shown to be: “…often on a higher cognitive level than that guided directly by the teacher” (392). Therefore, a report of this kind can inform educational practice through a kind of ‘natural history’ approach. It captures collaborating under authentic (schooled) conditions and makes the direction of learners’ thinking accessible for reflection by those designing instruction for such topics. Findings from research of this kind will be discussed in Section 3.2.

In our final example (C), Jiang, Zheng and Han (2017) gave primary school children the (after-school) goal of collaborating to build a LEGO structure.

In this experiment, the 12 [4th grade] participants engaged in LEGO activities after school four times in total, once per week. For each activity, the teacher created a situation and then proposed a problem that the participants needed to solve collaboratively. Each group discussed and constructed an artifact together using LEGO bricks to solve the problem in about 40 min without any intervention from the teacher. The process by which the students collaborated to solve the problem was recorded on video. Then, the groups demonstrated how their artifacts solved the problem in the created situation (131-132).

As with case ‘B’, the aim here was to describe how the students’ performed their thinking together. That description typically takes the form of categorising interactional moves and determining which are most closely associated with desired outcomes. Research of this kind can identify the strategies of thinking together that are most firmly liked to success.

**3 The collaboration: Researching outcomes**

Each of the above examples has students collaborating face to face, although similar interactions that occur over computer networks have also been widely studied. In both face to face and computer-mediated arrangements, a range of curriculum topics can be tackled as collaborations. So, in the illustrations of Section 2, historical events were interpreted, mathematical symbols were manipulated, and objects were built. These examples each seem to invite two lines of research. First, research on whether schooled collaborations are effective: evaluating them as a more or less successful educational method (cf. case ‘A’). Findings are discussed in 3.1. Second, research can scrutinise collaborations to determine which modes of interacting predict the most successful learning outcomes (cf. B’ and ‘C’). Those findings are discussed in 3.2.

**3.1 Study together or study solo: comparing efficacy**

Expressed bluntly, this section is concerned with whether or not collaborating works for learners. Or expressed as a practical question: should we be implementing such groups as a classroom method to promote learning? One place to start judging this is to consider examples of whole classrooms (or whole schools) that have pursued a general policy of group working (Johnson and Johnson, 1987). Such communities will typically be promoting a culture comprising: “…the instructional use of small groups in which students work together to maximise their own and each other’s learning” (Johnson and Johnson, 1999, p.73). When collaborating is evaluated in these whole-class or ‘policy’ terms, reviews of its research conclude that learning outcomes are typically positive (Johnson and Johnson, 1989; Slavin, 1996). That is, academic achievements (and student attitudes) exceed those from comparison classes/schools that centre instruction on cultivating and prioritising individual study strategies (Gillies, 2014; Johnson and Johnson, 2008; Kyndt, Raes et al, 2013; Pai, Sears and Maeda, 2015, Roseth,). That said, whole class group working can be managed in many different ways and success can vary across different implementations (cf. Stanczak, Darnon et al, 2022).

These findings do offer an encouraging foundation for supposing that collaboration is a strong educational method. However, a more focussed understanding is needed. Because the practitioner may often feel that an overarching or institutional policy of social learning does not fit every occasion or every local context. It may even be felt as oppressive. Besides, the effort of designing a targeted collaborative task will most often be effort applied at the level of a circumscribed classroom episode and so it is the intimate working of such episodes that most need to be understood. Consequently, research designs discussed next consider individual episodes of collaborative problem solving: asking how their outcomes compare with those from students arranged to address the same material solo.

Intuitively, we surely presume that a session of collaborating should be a particularly rich context for thinking through problems. Because, we argue, surely a group solving a problem together can draw upon pooled expertise. And multiple voices mean more probing debate and critique – more quality control over analysis. Consequently, one thing research can do is check whether the product of a collaborating group is superior to the typical product from a student working solo. And indeed, it is. However, that is a poor comparison for underpinning our faith in *learning* from collaborating. It merely implies that the typical working group generates something superior to that from the typical individual working solo. A one-and-only ‘best product’ may sometimes be what is wanted, in which case it is generally wise to convene a group to do the job. But usually in educational contexts, what is wanted is something closer to ‘the richest learning experience for the greatest number’. Finding whether collaborating distinctively achieves this demands a more careful research design.

Attention must focus on the consequences of a collaboration for its individual members. Is the average learning achievement of those in the group greater than that for others studying solo? The following research design has been widely adopted for addressing collaborating in these terms. Convene a large number of learners and assess each of them on some topic that they will be asked to study further. Then allocate some to study the topic collaboratively and others to study it solo. Afterwards, evaluate each participant’s knowledge level again. Suitable statistics applied to performance differences will allow a judgement on the efficacy of learning from collaborating. That is, whether the average post-study achievement of those *individuals* who collaborated is greater or less than the average post-study achievement of solo*-*learning individuals (cf. Case ‘A’ in Section 2 above). There have been numerous studies of this kind.

That research design, as just described, is only a template. So, the researcher can populate it with a variety of design choices for collaborating: most obviously, around the time allocated, the topic to be studied, and the size of groups studying it. But also, who the participants are and how they might be mixed together – around age, experience, gender etc. In short, given this range of choices, no single research study can be definitive about the potential learning consequences of a collaboration. When research evaluations are plentiful but mixed in their details of design, the strategy has been to assemble all these studies in order to review and summarise their outcomes: this is termed a ‘meta-analysis’ of published findings. Such an analysis on schooled collaborations has been conducted by Tennebaum, Winstone, et al (2020). They summarise results from research in a range of educational contexts covering childhood and adolescence. The direction of research findings was strongly towards individual students experiencing more positive learning outcomes from tasks set for schooled collaborations than for the same material studied solo. This conclusion generalised across different gender and age groups and to a wide variety of study tasks set. A similar conclusion was reached by Lou, Abrami and d’Apollonia (2001) from a meta-analysis of research on small groups collaborating around or through computer technology.

For many practitioners concerned to implement collaborative learning episodes, these summaries of research findings may offer enough encouragement to trust the method. However, the positive findings from meta-analyses are necessarily an incomplete story. For example, they can encourage over-confidence in collaborative learning because they will exclude studies rejected for publication (or not submitted) because the research failed to find a learning effect. Although a number of studies have reached publication that do illustrate a failing to find an advantage for collaboration episodes (Baron, 2003). Positive outcomes are not inevitable. On the other hand, *under*-confidence in collaborative learning can arise from failing to give weight to studies that only find a detectable impact on learning some time *later* – a kind of incubation effect of collaborating (Howe, McWilliam and Cross, 2005). All of which leads some commentators to conclude that the questions for research cannot be about *whether* a schooled collaboration better supports learning but *when and how* it does (Kirschner, Pass & Kirschner, 2009; Nokes-Malach, Richey, and Gadgil, 2015).

At this point, the concerned practitioner might be inclined to stop reading. After all, it seems that individual outcome studies cannot be definitive, while *summaries* of efficacy research are hedged about with health warnings on how they should be interpreted. Moreover, it can always be asked what it is that research shows a collaborative learning episode to be better than. The typical research design will compare learning in a collaboration with some control (non-collaborating) alternative. For this, the ‘business as usual’ chosen by researchers is often a text-based, solo study episode (cf. Case ‘A’ above). Yet, in typical situations of teaching, the choices may be much broader and their fit to individual students, individual classrooms and available resources may allow wise matching of learner to method.

In sum, research on collaborative learning does broadly encourage its implementation but it cannot be authoritative for addressing simple does-it-work or doesn’t-it work questions. More confident guidance for the practice of implementing collaborations must come from a closer understanding of the processes involved in thinking together. So, it is still worth reading on. Because research can inform decision making when it reveals more about that *process* of collaborating when the nature of collaborative talk is scrutinised (Section 3.2). Research can also advise on how attending to design options for convening a collaboration can optimise the subsequent flow of that interaction (Section 4). Finally, useful insights that inform practice can be found by digging deeper into the nature of the mental processes that characterise thinking together (Section 5). All of this can be set against our judgement as to whether humans actually have a disposition to collaborate (Section 6). In the end, practical guidance will most often be built upon a personal integration of these research leads.

**3.2 Styles of collaborating that can influence outcomes**

How people interact during collaborations has been widely studied. This is unsurprising, because thinking together is a strategy for decision making and problem solving in all sorts of human predicaments. The remainder of this chapter identifies a number of themes that have recurred within research aimed at understanding or designing schooled collaborations. In the present section, we review those features of collaborative talk that are thought most relevant for stimulating effective learning.

The first and simplest requirement of collaborative effort must be the will of participants to pool disparate knowledge: that is, individuals venturing material that they believe is important to have in place as shared. Baron (2003) reports that the more successful groups were those that were open to the contributions of all their members. However, once a willingness to take part is established, the contributions of collaborators must go beyond knowledge pooling and must aspire to the character of something closer to the term ‘debate’. There are four themes that are widely encountered in research on effective collaborating; they will be considered here under the following headings: reflection, resolving, converging, and regulating.

**Reflection**

When a group member contributes to discussion, they will often go on to explain the significance of what they have said to partners. However, while making their thinking explicit for others, the owner of that contribution will also be making sense of it to themselves. By publicly tabling an idea, they will be indirectly articulating why they hold that knowledge or belief. The contract of a collaborration invite such reflections. Gourgey (1998) gives numerous examples of what moments of reflection might cover. Taken together, they illustrate how a collaboration creates pressure for what psychologists’ term ‘meta-cognition’. That is, thinking about thinking itself. By enforced clarification of what one knows, the individual acquires more confidence in how to manage and apply it. Other than within collaborating, many students can struggle with presenting their ideas along with adequate explanation or expansion. Roscoe and Chi (2008) illustrate this even for undergraduates. Participants were asked to tutor fellow students but they typically responded to the uncertainty of their peers by simply restating or paraphrasing information without significant elaboration. However, interacting with a collaborator (rather than a tutee) solicits a richer and more reflective dialogue. Not that opportunities for reflection are entirely a consequence of hearing one’s own contributions. Listening to the ideas of others also offers opportunities to self-monitor: one gets to recognise and reflect upon possible gaps in one’s own understanding.

**Finding resolutions**

Progress in collaborating depends on participants actively making contributions. However, those contributions may sometimes be challenged or contradicted by peers. Yet this may be productive. Because any resulting conflict can be a prompt to discuss new directions of compromise or otherwise to explore alternative reasoning together. The theorist Jean Piaget was an influential voice stressing the constructive role of conflicts. He highlighted the value of the thinking that resolves them. Of course, disagreements do not always enjoy productive resolution. Collaborators can be skilled at disposing of them, rather than exploring them. For example, in several research projects it has been illustrated how conflict can evoke reactions such as rejecting, ignoring, excluding or temporarily parking an issue (Barziliai and Ka’adan, 2017; Kienhues, Stadtler and Bromme, 2011; Kuhn 2020). However, where the conflict is task-related and confronted, this has generally been shown to support learning.

Conflict during a collaboration can help with the problem currently being tackled but it can also support cognitive development in a more far-reaching way. This is because conflict can highlight how perspectives can differ and yet remain authentic. Views that are conflicting can stimulate for learners a range of insights regarding the very nature of a rational understanding. For example, they can help break down young people’s tendency to see causality in ‘one-variable’ terms – complex circumstances understood has having singular causes (Grotzer, Derbiszewska and Solis, 2017). So, contrasting viewpoints can become recognised as equally valid and potentially capable of being made compatible. Such occasions that require the management of differing perspectives can prompt a more mature understanding of knowledge itself: in particular, that it must invariably be a matter of human judgement (Kuhn, 2020).

These observations regarding conflict remind us that collaborating cannot promise interactions that are necessarily harmonious. Practitioners who design collaborations may feel uneasy when organising conversations that welcome conflict. The same uneasiness may be felt towards encouraging argument as a particular structure for thinking together with peers. Yet arguing is a powerful arena in which participants’ knowledge can be re-configured (Kuhn, Zillmer et al, 2013). Not that arguing will ever be an unfamiliar experience for young people. However, this does not mean that they can easily adapt to its ‘schooled’ version. One large-scale study aiming to cultivate competence with argument shows that interventions with 11–16-year-olds can remain unsuccessful even when extended over two years of schooling and reinforced by extensive teacher development programmes (Osborne, Simon et al, 2013). Indeed, Kuhn and Lerman (2021) have demonstrated in two studies how 13–14-year-olds may manifest only limited appreciation of what argument requires as a productive reasoning process. They conclude: “…the desired understandings of the link between evidence and claim and of the limitations of different forms of evidence in relation to a claim are not understandings that we can assume to be in place in young adolescent students, even ones who have had frequent opportunities to engage in evidence-based science inquiry activities” (p.1048-9). Nevertheless, the researchers assert that persistence with the schooled organisation of collaborating-as-argument will help cultivate this powerful form of reasoning (Shi, Matos and Kuhn, 2019)

**Generative Convergence**

Collaborators will rarely start from the same place. So, differences in knowledge and understanding will often be manifest early within a group. If collaborating is to work, its members must confront these differences creatively. Sometimes they will be regarded as conflicts but then – as outlined above – the act of resolving them may usefully contribute to learning. Alternatively, in the absence of apparent conflict, the distinctive contributions of partners may simply be accepted and added into the group’s emerging resource of common knowledge. However, the contributions of others are most effective when dealt with more deeply. When dealt with in the manner that was identified in Chapter 1 – by making a ‘generative’ response to them. That was earlier defined as “…actively making sense of to-be-learned information by mentally reorganizing and integrating it with one’s prior knowledge” (Fiorella and Mayer, 2016, 717). This entails individual members each taking the contribution of others as a stimulus to supplement or reconfigure an existing knowledge structure of their own. This kind of personal reaction to incoming, fresh contributions affords the (engaged) participant a deeper encoding of what is being studied.

However, this generative process of knowledge building can also take place at the group level. Generatively incorporating new material can be purposefully orchestrated within the group’s discussion. Such a process is sometimes termed ‘co-construction’. It refers to the involvement of group members in organising a *collectively* generative response and so establishing a shared route for knowledge building. The term ‘convergence’ is often applied in this context. For example, Roschelle and Teasley (1995) refer to this as a defining feature of collaborating: “...coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem” (p. 70). As collaborators invest in that effort, they will, in effect, be exploring the whole knowledge space that surrounds the particular problem under consideration. When Chi and Menekse (2015) correlated successful learning outcomes to different patterns of collaborative dialogue, they found that the greatest success followed discussion where collaborators were mutually constructive in this way. Although one factor that can determine how far co-construction is activated is what collaborators are told is the purpose of their collaborating. In a study with college students (Mercier, 2017), co-construction was found to be more vigorous if the students understood that the task was for learning, rather than just something they should try and do well at.

**Regulating ourselves**

Both co-construction and, to some extent, the resolution of conflict are responsibilities that collaborators will often recognise as important – particularly when the collaboration is explained to them as a support for their learning (Mercier, 2017). However, progress is greater when these generative responsibilities are made *explicit* within a group. That is, a recognition that the group’s thinking and communication needs to be coordinated or regulated by its members. Sometimes that is a role that might be taken up by a particular individual. Or sometimes it may be more evenly shared. Either way, what this entails is another example of meta-cognition: that practice that is often pursued as a *personal* cognitive strategy becomes, during collaboration, a collective responsibility within the group (Volet, Vauras and Solonen, 2009).

There is much research on the strategies adopted at different ages to realise this communication management, or ‘social meta-cognition’ (Järvenoja, Törmänen et al, 2023). What is involved in effective collaboration must be more than simply exchanging ideas. It requires interventions that set standards and aims for interaction, while also monitoring how far those ambitions are both understood and being met. It requires an effort to maintain group focus and persistence – ensuring there are limited distractions or otherwise disengagement. Groups that work on these responsibilities tend to be more successful when it comes to learning outcomes (Näykki, Järvenoja et al (2017).

The four themes outlined in this section are key ingredients for a collaboration becoming a powerful learning resource. But this last theme, group regulation, is particularly important for its role in ensuring the *participation* of members. Remaining engaged is an obvious condition for the individual to experience learning: i.e., through the opportunity for self-reflection, or becoming involved with the resolution of differing perspectives, or following the trajectory of converging thought. This last one is particular crucial for cultivating in the individual a sense of participation. Members of a collaborating group can sometimes become marginalised. Where this happens, those individuals may have limited experience of the important generative thinking that collaborating can stimulate. The participant who is less engaged may well be a *witness* of their group’s conclusions while not an active agent in reaching them.

However, the achievement of meaningful participation is not something dependent only on the group members own efforts of publicly reflecting and regulating around what is being said. Such group articulation of progress can be made more likely by the way in which a collaboration is designed in advance of the encounter. Section 4 below, considers some of the ways in which collaborating can be structured from the outside.

**4. The collaboration: Structuring it for success**

Outcome research indicates that collaborating is generally an effective act of learning. However, while a learning advantage is the typical finding, evidence on the extent of that advantage is mixed (3.1). Moreover, research that reports the implementation of collaborative learning finds that many teachers can be uncertain about its value: being sometimes positive (e.g. Liebech-Lien and Sjølie, 2020), but sometimes hesitant (e.g., Abramczyk and Jurkowski, 2020). Given the above examples regarding forms of interacting that are effective for learning (3.2), what can be suggested by way of optimising the prospects of a collaboration being successful? Research encourages at least three potentially fruitful possibilities for structuring a collaboration: strategically convening the membership of groups, pre-training members in the necessary sensitivity for thinking together, and inserting external prompts to guide their discourse.

**Group chemistry**

For a collaboration to be successful, its participants need social competencies that cannot always be taken for granted. They need to understand the individual contributions of others and, in doing so, work towards regulating a collectivity of understanding. The togetherness in ‘thinking together’ entails confidence in reading the intentions and attitudes of partners. Informally, this may be termed a kind of ‘mindreading’. Although psychologists refer to it more in terms of ‘intersubjectivity’. This concept is important to explain, because it appears in other chapters of the present book. *Subjectivity* refers to an individual’s momentary cognitive or emotional state. *Inter*-subjectivity is then a *mutual* awareness between people regarding their respective subjectivities. (This is a mutual awareness, not necessarily an empathy.) The ability to ‘read’ the psychological states of others is now regarded a deeply human capability (although, of course, fallible). Indeed, being able to strategically coordinate with others in this way is commonly invoked when explaining human evolutionary success.

Intersubjectivity must be mobilised in a collaboration for a collaboration to be most effective. Partners need to understand each other but also *want* to understand each other. So, how can recognising this form part of a design strategy by those who convene these learning events? Some commentators have suggested that the informal social dynamic of a classroom community too often gets overlooked as a resource when organising group work (Blatchford, Kutnick et al 2003). For example, intuition suggests that pre-existing friendships might encourage group members to be more motivated and active in sharing their thinking. In a collaboration, existing friends could draw from their established experience of shared understanding and intersubjectivity. Certainly, students will often profess a preference for working with friends, if given the option (Lintner, Diviák and Nekardova, 2024). Kutnick and Kington (2005) have reported one study involving years 1, 3 and 5 of primary school that explored friendship pairings in science reasoning tasks. Such pairings were generally found to facilitate performance. Yet there is judgement to be exercised here: because they can also sometimes inhibit it. In Kutnick and Kington’s study, girls’ friendship pairings had the highest performance while boys the lowest. It is no surprise that a history of mutual familiarity will become active during the demands of classroom collaborating. This can be a resource for organising groups although it is likely to depend on the valuable insight of an overseeing teacher, rather than any easy rules-of-thumb.

**Preparation**

If the collaborating of students does lack the kind of interpersonal receptivity sketched above, then there may be interventions that can help cultivate it. An influential concept in psychology for defining this kind of social or cultural knowledge is the ‘script’. A textbook illustration of this is the restaurant script. Cumulative experience of visiting restaurants equips us (even as young children) with an understanding of how to act there and what to expect of others. By analogy, we may acquire scripts for a collaboration or even scripts for different forms of collaboration – such as an argument or a debate. Some researchers have worked at cultivating within classrooms such discourses of social reasoning (e.g., Mercer, Dawes et al, 2004). This has included pre-establishing greater confidence with the scripting of collaborative talk: finding it can make a difference to the quality of shared problem solving and its outcomes (Mercer and Littleton, 2007).

Mende, Proske and Narciss (2021) have published a meta-analysis of research on preparing students for groupwork projects: they report that the most effective preparation for collaboration resides in practice tasks that require generative thinking. That is, the strategy of using the contributions of others to actively infer new knowledge, or integrating those contributions with existing personal knowledge already in place.

However, a simpler form of preparation may be for the convenor of a collaboration to specify a kind of ‘contract’ for what must take place during thinking together. For example, in their meta-analysis of the peer collaboration literature, Tenenbaum, Winstone et al (2020) conclude “… a simple amendment to task instructions, whereby children working in dyads or groups are instructed to reach consensus through interaction, can lead to greater gains in learning” (p.1315). Imposing an expectation that agreement or closure must be achieved exemplifies a simple ‘contractual’ arrangement that make a significant difference.

**External prompts**

Interventions described above as ‘preparatory’ aim to strengthen students’ internal scripts for collaborating. However, that scripting of action can be shaped *externally* – during the collaborating itself. This can be achieved by delivering at key moments specific suggestions for appropriate conversational turns, although this is something most readily implemented in computer-mediated collaborations (Koller, Fischer and Slotta, 2007). Such insertions can prompt useful next moves (e.g., “ask for evidence”, “sum up where you are”) or moves specific to the point reached in a task. Such external scripting is a method that has enjoyed success. Dillenbourg (2007) has pioneered it but he has also urged care in its use, warning against ‘overscripting’. Because the sometimes-mechanical interventions of a script can disturb the spontaneous flow of interactions, or some natural order in which components of a task are tackled.

A significant motive for all interventions of the sort discussed here is to encourage collaborators into making their reasoning explicit and, therefore, visible to partners. This better enables group members to be participants in the generative production of the group’s conclusions and, ultimately, it promises the most effective learning. However, this inclusive quality of collective thinking may be greatly helped by material supports available in the environment where that thinking takes place. For example, although participants may make their private reasoning transparent through what they *say*, the goal of transparency may also be achieved by generating and sharing written notes. Such notes would be an external resource that enhances awareness of collective progress in the task being addressed. Similarly, the physics students in our Case ‘A’ above (Section 2) may helpfully make their thinking shared as they each perform written calculations or diagrams.

Yet this example of ‘visible thinking’ highlights a very general point about the value of shared reference points located in the environment of collaborating. For example, the LEGO building of Case ‘C’ (Section 2). There, an emerging design visibly speaks for itself. Both the history of the collaborators’ building decisions and where they might go next are available and shared in the physical form before them. The example illustrates how the progress of intersubjective communication is supported by being able to direct partners attention to visible references points in their shared environment. Indeed, one reason that computers became prominent in classroom collaboration may have been their ability to make otherwise abstract components of reasoning visible, manipulable but – most significant of all - *sharable* on their screens (Crook, 2000).

Psychological theory cannot prescribe watertight strategies for the implementation of successful collaborative learning episodes. However, in scrutinising what takes place in such episodes, research has derived a set of concepts that may nevertheless inform design decisions. The three directions reviewed in the present section illustrate how those concepts can underpin such practical decisions.

The direction taken so far in this Chapter can be summarised as follows. At the outset, a form of thinking together was identified that we termed a ‘schooled collaboration’. Not unique to schooling but commonplace there and perhaps a foundation for subsequent approaches we take to collective problem solving. Evidence was summarised that tended to encourage this as an educational design supporting the learning of those that took part. Four features of collaborative interaction were identified as important to the success of that outcome. While in the present section, principles that underpin the design of such interventions were suggested. Many of the research insights reviewed above help clarify the nature of collaborating as an act of learning. However, they do not furnish rules of thumb for effective practice. Confidence in being a collaborator or confidence in designing collaborations may both gain from engaging with two overarching psychological themes. In the final two sections, we consider first the mental processes that underpin ‘the collaborating mind’ (Section 5) and, second, the psychological roots and profile of the ‘collaborating individual’ (Section 6).

**5. The collaborating mind**

Discussion of collaborating often invokes the claim that ‘two heads are better than one’. What can this imply? Given that the adage is so persistent, it must imply something less mundane than, for instance: ‘two eggs are better than one’ (in an omelette). Of course, with thinking, as with cooking, it may always be useful to add more content. So, the extra head added to a thinking task might allow the necessary work to be divided up. A kind of labour distribution advantage. But a more interesting implication is that the two heads brought together can gain their advantage through achieving some form of mental integration. A coordination that makes the thinking greater than the sum of its parts. Successfully implementing such a mental dynamic may create more progress for partners solving some problem together than simply having them divide up the labour. And, perhaps, the task becomes more enjoyable. Finally, it may give a greater benefit to the learning of each collaborating partner – something this chapter concerns.

The present section is about framing the ‘two heads’ advantage in these more singular terms: seeking to define a kind of mental coordination. One that leads to recognising the idea of a ‘collaborating mind’ as a useful concept. Psychology has models that describe the workings of the internal, or solo-working mind; how could it also model a form of *shared* mental activity? Our purpose here is to explore this. It will require to start with an outlining of the prevailing model of basic, or internal, cognition in psychology. This model will be foundational to any account of how minds in collaboration are to be understood. Second, it will involve acknowledging the limitations of approaching cognition in these exclusively ‘internal’ terms: expanding this traditional account by considering the sense in which mental activity is commonly *externalised*. It is this more versatile conception of mental activity that grounds the possibility of – and reveals the ubiquity of - the collaborating mind. Finally, what emerges may help explain why some collaborators do not learn well from the experience.

**5.1: A triadic model of mind**

Cognitive psychology’s foundational model of mind involves three components. Two concern memory, which is considered in structural terms as long-term memory (LTM) and working memory (WM). The third is a diffuse and overarching process commonly termed the ‘executive function’. To help elaborate these core mechanisms, they will be illustrated here through a concrete example. So, imagine the mental demands on a student who is working solo on a typical schooled problem. For example, an historical interpretation, rather like Case ‘B’ in Section 2 above. So, let’s consider the thinking trajectory of a student answering an exam question on a topic such as: ‘King Henry VIII and the Church of England’.

Long-term memory is a database of stored knowledge whose architecture forms a dense network of associations. So, a student’s remembered material - such as ‘Cardinal Wolsey’ (Henry VIII’s advisor) – exists as nodes in this network. ‘Wolsey’ will link with other nodes (‘Anne Boleyn’, ‘the Pope’, etc.) with varying strengths according to how the student has previously encountered them presented in association. In this way, the *patterning* of networked links serves to code what we would casually term a concept’s meaning (e.g., a concept such as ‘papal authority’). Inevitably, a concept’s meaning will vary between individuals because of their unique histories of interacting with relevant sources and thereby forming distinctive associations between those sources. Now consider how LTM is *used*. The lone student’s recovering of a helpful target – such as ‘Wolsey’ – requires a starting point, or a ‘prompt’. The prompt’s value to problem solving will depend on how close it happens to be to the required target in the student’s memory network. Starting from the prompt’s location, a process termed ‘spreading activation’ will occur, bouncing through neighbouring candidates until arriving at a task-relevant node such as ‘Wolsey’. But where does the student find the prompt in the first place? If they happen to be already immersed in the history invoked by the exam question (say, Tudor England), then a valuable target such as ‘Wolsey’ may actually come to mind all at once – with no conscious awareness of the activation pathway that led to it. However, on other occasions the student may have to *self*-prompt with whatever other ideas come to mind from the ‘Tudor England’ starting point.

Retrieval is the first component of memory use. However, the student needs to sort and integrate this material retrieved from LTM into an interpretive historical narrative. That integration might also incorporate material from the immediate perceptual environment (if the student is not in an examination, this could be a textbook). Working memory serves as the processing engine for this integration. It juggles its input in a to-and-fro traffic with LTM. It then updates LTM with items that might be newly-formed through this process. However, this is a challenging process because WM is fragile. It has limited processing space and its contents have limited duration, if not rehearsed.

The fragile and transitory nature of WM requires the involvement of the final member of this triadic model: the executive function. These comprise a set of operations; one of them concerns the updating, integrating and monitoring of activity in working memory. However, the executive function involves a wider range of other umbrella management tasks. In particular, it will support exploratory thinking by managing the student’s shifting between mental tasks. Moreover, it will also inhibit responses that may compete with a central task (e.g., the student reaching for their smartphone).

The model sketched above is complex in its detail (albeit not explored here) but simple in adhering to a perfectly common-sense understanding of mental life: a traffic of operations executed ‘in the head’. Such a conception of thinking is echoed by those items commonly found in intelligence tests: puzzles to be quietly solved in private thought. Of course, such a mental life is very real but insisting on its cranial containment risks prioritising a rather Sherlock Holmes version of thinking – withdrawn pondering. However, this is something most of us do not much relish and often find hard to sustain. Accordingly, there has emerged within psychology a broader conception of mental life – and one that, incidentally, happens to explain how we manage to avoid too much exclusively inward thinking. This is a model that re-drafts what ‘thinking’ means by showing how we couple activity inside the head to those contexts that the head is inside of – the environments we think in. The thinking process is thus *externalised*. The following section will explore what such a ‘coupling’ entails and, then, how this fresh conception of thinking helps us understand the natural dynamic of collaborating.

**5.2: The mind extended**

The phrase ‘extended mind’ may be unfamiliar, yet it has become favoured by many cognitive psychologists who theorise mental life (e.g., Clark and Chalmers, 2010; Rowlands, 2010). To understand the mind as ‘extended’, it helps to notice how the various environments that we act in seem to have intelligence built in: often put there by ourselves, sometimes inherited from the past effort of others. Thinking extended into the world is partly about coupling thought to the opportunities lurking in that external design. Saying intelligence is ‘in’ the world may make more sense if we reflect on the layout and resources of typical thinking environments: offices, workshops, laboratories, kitchens, studies etc. These are environments that manifest intentional design: contexts built to assimilate and extend thinking. The way we organise space and its contents is to best support the mental efforts of memory and reasoning that must go on there. So, the physical things we will require are strategically positioned to prompt their use when needed and to facilitate moving among them as some direction of thinking develops. In consequence of such design, there is less remembering and reasoning to be done only in the head. Structure designed into the external world scaffolds and augments our internal effort of thinking. The environment provides not just the data for thinking (texts and pictures etc.). It’s furnishing also supports the *process* of thinking.

Prominent in such spaces there will be various tools. First, of course, there are tools that are important simply because they act directly on the environment and realise our purposes for working there (staple guns, kitchen whisks, hammers and saws etc.). But there are also tools that augment the work of internal thinking; again, by allowing some operations of thought to be pursued and completed externally. Mobilising such tools is sometimes termed an ‘offloading’ of cognition (Risko and Gilbert, 2016), because doing so relieves certain demands on the mind’s internal computations. So, if the product of thought requires mentally juggling numbers, we might offload components of that work to a calculator. If it requires mentally constructing a route, we might insert a GPS into the travelling. If something must be remembered, we might write it down. At these everyday moments, the computations of thought (the calculating, the navigating, the remembering) are pursued through our coupled relationship with such ‘tools to think with’.

That last example (the notepad) is particularly compelling. By externalising our thoughts through the tools of writing, symbolising or drawing, we impart to those thoughts a physicality that allows them to be externally stored, retrieved, appended, manipulated or revised (Allen, 2024). So, the management of such external marks becomes coupled into the trajectory of our internal thinking. Surprisingly, the cerebral Sherlock Holmes seems to have resisted this kind of tool. He rarely annotated his thoughts (although see *The Adventure of the Devil’s Foot* for an exception).

On the other hand, Holmes does adopt another method for coupling thinking to the external world: one very relevant to this chapter. He recruited his partner Watson as a (social) ‘tool to think with’. For example, the pair of them might recall together significant events around a case. Or some line of reasoning might be tested by jointly exploring it. (In *The Hound of the Baskervilles* Holmes remarks to Watson “it may be that you are not yourself luminous, but you are a conductor of light”.) Because the extended mind model regards intelligence as a capability that incorporates tools in the world, it can surely include that part of the world that is other people. The act of collaborating allows one’s private thought to be interleaved with the publicly shared thought of other people: i.e., a process of coming to locate one’s thinking within a *socially*-extended mind. A mind whose data structures and operations thrive from an externality that couples itself into the thinking of other people. The next section considers the working of such a collaborating mind.

**5.3: Socially-extended thinking, or the ‘collaborating mind’**

If it is meaningful to invoke a mind that is *socially-*extended – a collaborating mind - its structure and functioning should mirror that of our mind when thinking solo. To illustrate what such a unified entity means, consider again the student addressing ‘King Henry VIII and the Church of England’. But, now, in partnership with a collaborating peer. In which case, a useful image for the storage aspect of memory is the Venn diagram (Jeong and Chi, 2007). Each partner has their own ‘circle’ of knowledge and, to some extent, those circles will overlap. The overlap will be discovered through interacting with partners and its contents will be stored for use by such socially-extended minds as material to be worked upon together or ‘common knowledge’: (Baker, Hansen, et al, 1999; Teasley, 1997). A collaboration can therefore be said to create a *shared* long-term memory (sometimes termed a ‘transactive memory’).

Now consider how such shared memory is used, how it is searched. Collaborating history student ‘A’ night declare that they are struggling to find a certain target – say, a key English churchman. Perhaps commenting that he was an important advisor to the King. Then partner ‘B’ might share the searching by externally offering useful prompts. A remark from ‘B’ such as “wasn’t there a ‘Cardinal someone’?” might lead partner ‘A’ towards the finding of ‘Wolsey’. In this way partner ‘B’ has functioned as that ‘extended mind tool’ for partner ‘A’s’ thinking, with an outcome that has added to their shared memory. In the course of such exchanges, the partners may gather a mix of material that is foundational to the task: Wives, Boleyn, Divorce, Wolsey, Pope, Authority, Reformation, and so on.

However, such material must be processed in order to construct an interpretative narrative around it. This is what the individual does with working memory. But, as noted earlier, the WM of an individual is fragile. Yet collaborating can compensate for such constraints by externally distributing the operating needs of WM among thinking partners. Accordingly, during collaboration, this organisational and creative aspect of memory can be considered mirrored in a working memory system that is a *social* structure. It is manifest within the to-and-fro traffic of conversation around items accumulating in the group’s shared memory. Just as with the individual thinker’s working memory, this social realisation of WM also functions as a processing space. But the processing is conducted though the exchanges of social interaction: a coupling together of the private thinking of individual participants (Kirschner, Paas and Kirschner, 2009).

The productive nature of this cognitive integration will help address whatever problem was allocated for collaborating. That is welcome. But does it also have lasting impacts for the individual participants in such a collaborating mind? Two possible consequences can be considered. The first involves asking whether participating in externalised thinking has *general* positive implications for a participant’s cognitive development. The second asks how such engagements can enhance *specific* learning consequences: that is, learning relevant to the particular task involved; for example, interpreting Tudor history.

On the first consequence: the externalisation of thinking, as described here, resonates with Vygotsky’s proposal that individual mental capabilities are formed within socio-cultural engagements or, expressed differently, that the *intra*-psychological originates within the *inter*-psychological (Vygotsky, 1986). What this implies is that being an agent in the joint processes of collaborative thinking would allow those processes to be internalised and realised at later times as private thinking. Such a perspective therefore asserts that cognitive gains of a vey general kind arise from the experiences of collaborating. A whole range of situations in which learning is found to follow from structured social interactions strongly reinforces this internalisation proposal. Although it has proved hard to demonstrate the exact mechanism whereby it occurs.

The second question to consider is how participation in a collaborating mind might enhance learning in relation to the specific topic being studied: Tudor history in our example. This question is closer to the central theme of this chapter and invites fuller consideration.

As discussed in Section 3.1, there is considerable evidence indicating that learning does follow from such collaborating. While Section 3.2 surveyed something of how this comes about. However, also in Section 3.1 it was noted that collaborating does not always and everywhere lead to a learning advantage. Consequently, the operations of the collaborating mind need to be examined for the possibility that they may inhibit learning as well as facilitate it. After all, there is something that may feel inherently fragile about coupling an internal train of thought (myself thinking privately) into an externalised or public train of thought (us thinking together). Closer examination of the collaborating mind in action reveals circumstances in which cognition, and hence learning, may be inhibited.

**5.4: Collaborative inhibition**

Collaborative learning is not the only arrangement affording investigation of collective thinking. People also think together during brainstorming. That is an arrangement not usually intended to foster learning (although it may happen); its typical purpose is to optimise the recall of important material or to generate new ideas. Its effectiveness for memory can be evaluated as follows. First, show participants items to be remembered. Later, some participants must recall them together as a group, while others (the same number) recall them individually. Surprisingly, the number of items recalled by the collaborating group is *less* than the total from all the individuals recalling alone (e.g., Rajaram and Pereira-Pasarin, 2010). A similar pattern is reported when the collective task is not remembering but creative thinking (e.g., Wiley and Goldenberg, 2023). Both the quality and quantity of ideas from group thinking are inferior to the aggregate of what the same number of individuals achieve from thinking alone (redundant duplicates are excluded). Such results seem to challenge ‘two heads are better than one’. Or, expressing that tension concretely: if 10 individuals thinking alone can generate 20 unique ideas between them, then it seems surprising that a group of 10 individuals thinking together come up with *less* than 20 ideas. It would appear that the collaborating groups are underperforming. They are failing to capitalise on the capabilities of their members. This finding has therefore attracted the description ‘collaborative inhibition’ (Barber, Harris et al, 2015; Basden, Basden et al, 1997). It relates to brainstorming but clearly is relevant to collaborative learning.

The term ‘inhibition’ implies that the collaborating mind can sometimes constrain what an individual member could potentially contribute. Consider this in relation to the collaborating history students. Suppose student ‘A’ externalises their memory search by saying: “there was some advisor to the King – maybe his name began with a ‘C’”. History student ‘B’ then says “Thomas Cromwell!” This does fit and so it may be accepted by the group. But suppose student ‘A’ was actually searching for Thomas *Cranmer*. That item may now be lost to the common knowledge (and perhaps Cranmer’s role in the narrative may then go missing also). Another form of participant inhibition can occur when those ideas that come *first* in a discussion are given heightened prominence in the group talk that follows; so much so, that future alternative or additional ideas may be deterred from being raised. Such a pattern has been reported as a common ‘fixation’ effect in brainstorming. The earliest ideas get locked onto or, sometimes, the ideas that are associated with those group members perceived by their peers as expert (Kohn and Smith, 2011).

These examples illustrate one way in which the socially-extended mind can inhibit as well as facilitate progress. But ‘collaborative inhibition’ can also describe what happens when an individual simply becomes dis-engaged from thinking because of reluctance to participate in the group project – although the roots of such disengagement may vary from routine anxiety through to active exclusion. Such inhibition is grounded in the recurrent finding that individuals working in a group generally invest less effort in striving for a goal than they would if working alone. This was first demonstrated over 100 years ago by Maximilien Ringelmann. He monitored the effort levels of individuals while pulling together on a rope. The measured effort of an individual when part of a group (i.e., in a tug-of-war) was less than the effort exerted by that individual when acting alone. Moreover, the larger the group, the greater the reduction of effort. This ‘Ringelmann Effect’ was later replicated by others for a variety of tasks (Ingham, Levinger et al, 1974). Psychologists have termed such managed disengagement ‘social loafing’ (Arterberry, Cain, and Chopko, 2007; Gabelica, DeMaeyer and Schippers, 2022).

However, research has identified other ways that the group dynamic can inhibit engagement – ways more subtle than deliberate loafing. Partners will bring into a collaboration different personalities, different motivation, and different vulnerabilities (e.g., Baron, 2003; Bell, Brow et al, 2018). In such cases, collaborating can inhibit task participation by arousing self-identification concerns. For instance, individuals may withdraw because they decide that their input is not sufficiently valued by others. Or because they lack confidence in the quality of the contributions that they feel able to make. Or they may merely contribute material already known by partners in order to receive approval or reassurance from the group. Such fragile engagement can mean that the group is denied the possible insights of those members but also that such individuals may themselves learn less from their experience of taking part. If such disengagement is not anticipated and repaired, the *potential* of collaborative learning may be underestimated.

This discussion has identified ways in which collaborating can sometimes act to inhibit the participation of some group members. Such inhibition may help explain the somewhat unexpected outcome of brainstorming research: namely, that output from groups thinking together may be inferior to output from a group of individuals each thinking solo. This is an effect on group productivity. But, more in relation to the present chapter, can these inhibition factors limit the *learning* of individuals collaborating in a group? The learning of an individual group member will depend upon the extent to which they had the experience of a *generative* involvement with the shared problem solving: whether they witnessed and/or participated in the train of thinking that led to some closure on the problem being tackled. The examples raised in the present section indicate how such participation can be constrained. So, the exercise of the individual’s personal remembering, or their creative imagination, may sometimes be disrupted or trumped by the contributions of others – variously termed ‘production blocking’ (Diehl, and Stroebe, 1987). They may thereby be less involved in the generative construction of important ideas whose understanding may underpin learning. Or, participation may be undermined by an individual conceding their effort to others; including through lacking confidence to contribute, or perhaps feeling actively excluded.

While earlier chapter sections identified ways in which collaborating *facilitates* learning, the present section has indicated how the collaborating mind can generate inhibitory effects and how these may explain why a collaboration episode can sometimes be limited as a learning method. Finally, the references here to participants actively evading collaboration (‘loafing’) does raise the question as to whether our human nature somehow prepares us for collaborative effort. This is a topic taken up in the final section.

**6: Becoming collaborative**

Humans are socially precocious. This is first evident in how newborn children perceptually orient to visual patterns whose configural properties are intrinsic to faces (Simion and Giorgio, 2015). Then, across the first year, children become *behaviourally* attuned with key people (Stern, 1971). At first, through simple imitation (Malatesta and Haviland, 1982) but increasingly within strongly emotional exchanges. Three months is often cited as a landmark with two particular developments. First, more complex playful agency and, second, exchanges with others that are increasingly integrated and sustained. Synchronies that Bateson (1979) termed infant/adult ‘proto-conversations’ start to form into sequences. These – by extension from ‘conversation’ – might be regarded as ‘proto-*narratives’* (McGowan and Delafield-Butt, 2022).

The human intersubjectivity outlined earlier in this chapter is apparent during infancy first in a ‘primary’ form whereby the infant’s subjectivity matches with a partner: they simply recognise and display complementary emotional states (Trevarthan and Aitken 2001; Terrace, Bigelow and Beebe, 2022). While the ‘secondary’ form (typically around 9 months) integrates the subjectivities of both infant and partner with some third-party presence. That is, the infant and partner achieve mutual awareness *with respect to* an external state of affairs (an artefact or event) that exists ‘between’ them. For example, jointly focussing on a toy in shared space. Such mutuality of understanding then allows progress towards deliberate shared action: a proto-collaboration.

The early presence of human sociality suggests two summarising propositions. First, that human infants are inherently prepared for interacting with others and, second, that such preparation implies our inevitably *collaborative* nature. With regard to the first: cross-cultural research will test the claimed universality of precocious sociality. It is well established that infant experience can vary widely across culturally specific child-rearing practices (Halberstad and Lozada, 2011; Lancy and Grove, 2010; Weisner, 2002). If the universality of Western contexts are questioned, it is usually by citing those child-rearing practices elsewhere that cast adults as more *passive* when relating to infants (Levine, Dixon et al, 1994). Yet other studies do suggest that sensitivity and synchrony does still exist but it is concentrated in very particular occasions of physical contact routines (Mesman, Basweli and Misali, 2021; Wefers, Schuhmacher et al, 2023). So, the first conclusion for this Section may be relatively secure: it appears that human infants do come prepared for social interaction which they pursue.

The second summarising proposition supposes that human beings are inherently collaborative. Yet if anything is ‘inherent’ to being human it is not so much collaboration as intersubjectivity. Certainly, the human capability for mindreading can be mobilised for collaboration. But it can also be mobilised for competition. Partners within a classroom collaboration may arrive with very different ‘intersubjective attitudes’. Perhaps depending on the appeal of the task, or through a history of earlier social interactions, or just by a passing mood. Such variation could mean participant resistance, as well as harmony. So, the second conclusion must be that human children are inherently *prepared* for collaborating. But contextual circumstances will determine whether and how that preparation is enacted. Put another way, intersubjectivity is not a promise that collaborating will always and everywhere drive learning.

The striking sociality of infancy implies peer collaboration will emerge and flourish during the pre-school period. After all, by the end of their first year, infants can read the intentions of others around them – an ability foundational to collaborating (Tomasello, 2020a, 2020b). In observing young children talking together during free play, it is easy to worry about whether what is being observed is or isn’t ‘genuine’ collaborating. However, this may distract us from a more significant topic: namely, understanding the *trajectory* of early thinking-together, a journey that starts in the early preschool years. Where it takes children is towards engagement with an increasingly formalised version of the playful exchanges termed here ‘schooled collaborations’. Evidence reviewed by Ramani and Brownell (2014), shows that joint talk within the free play of pre-schoolers demonstrates many features that could be mobilised later within schooled collaborations. Sadly, there is little research exploring how individual differences in such early joint thinking correlates with achievements later during more structured collaborations-to-learn. Certainly, pre-schoolers do demonstrate skills of coordinating their goals and intentions with others during play, but even at the end of the pre-school period they do not settle easily into schooled collaborations - when researchers offer these in advance of formal school experience (Ashley and Tomasello, 1998; Brownell, Ramani and Zerwas, 2006; Castellaro and Roselli, 2015).

It is important to distinguish what happens in the playground and what is required within the directed collaborating typical of classrooms. The exchanges of a preschool playground may be more hesitantly termed ‘collaborating’ by researchers but peer interactions will certainly become increasingly structured within the experience of formal schooling. Observations suggest that, by the end of the preschool period, many children are equipped with tactics suitable for such schooled collaboration, i.e., tactics more tuned to classroom problem-solving tasks. However, prior to the influence of schooling, when pre-schoolers are prematurely confronted with such classroom-style collaborations, their progress together is halting.

How individual children manage interactions within preschool play may be the best predictor of their confidence for thinking together with classroom peers – better than experimenter-managed preschool tasks (Ramani and Brownell, 2014). Teachers may reason similarly. For example, when they set up in-class opportunities for play that are not explicitly linked to curriculum goals. Ogden (2000) reports such a project, commenting: “…shared activities between peers provide valuable opportunities for children to engage in collaborative activity in the first years of schooling; such opportunities allow them to develop and *explore their roles as collaborators*” (p.224, emphasis added). Thereby children are brought together in a way that hopefully ignites more structured thinking together through play. In her reflection on this, Ogden is articulating a perspective that is quite widely shared: namely, that experience of making an effort to think together with others is worthwhile as an end in itself.

The brief review of social development in this final section has stressed our human orientation towards collaborative thinking. However, there remains a need for initiatives of the kind just outlined (Ogden, 2000), initiatives more concerned with learning to collaborate than collaborating to learn. When discussing above how the design of collaborations might be optimised (Section 4), one strategy involved providing students with more explicit guidance on how best to make contributions to joint activity but also how to help regulate it. This does raise a question regarding the baseline of confidence for collaborating that different students bring to school. Some may have a more firmly developed sensitivity than others for such joint thinking. In short, a collaborative disposition may be a significant dimension of individual difference. Sadly, this is a topic that has attracted rather little research. It has been expressed by some as a dimension of ‘psychological collectivism’ – meaning a positive orientation to the concerns and ambitions of groups that the individual belongs or a feeling of connectedness to those groups (Jackson, Colquitt et al, 2006). Some attempts have been made to monitor this in educational settings (Fransen, Weinberger and Kirschner, 2013; Wang, MacCann et al, 2009). Hopefully, the origins, consistency and impact of individual differences in collaborative disposition will become a stronger research theme in the future.

**7. Chapter summary**

In common with other chapters, this final section reviews the key psychological foundations underpinning the act of learning considered. If this chapter is longer than others it is partly because the topic has required introducing a significant number of those foundational ideas. Many of them will recur in subsequent chapters where their significance will be further developed. They are highlighted here in italic text.

Collaborating is a practice of integrating ones thinking with that of other people while pursuing a shared ambition of reaching some agreed goal. Early in life, the capacity of peers to think together in this way is formalised by educational practice into what is termed here ‘schooled collaboration’. Whether such relatively ordered structures benefit the learning of their participants has been widely studied. Methods typically involve pre- and post-testing on knowledge that is relevant to the goal being pursued during a collaborative episode. *Meta-analyses* of research findings on the efficacy of collaborative episodes conclude that it generally (but not universally) supports learning.

Certain features of collaborating have been identified as important for this learning. As well as exposure to the perspectives of others, there exists a stimulus for *meta-cognition* that arises from publicly articulating personal knowledge and also from actively seeking resolution of perspectives that conflict. Routine pressure to achieve convergence on those perspectives stimulates in participants a usefully *generative* response to collective understanding as it is experienced. An orderly trajectory for that convergence depends upon a *social meta-cognition*, whereby participants actively invest in regulating and systematising the course of their discussion.

Research accounts of how group discussion is performed have suggested a number of strategies for structuring the design of these schooled collaborations. Because human *intersubjectivity* is so important for regulating a collaboration, the significance of building on positive group chemistry was stressed. Collaborative discourse can also be usefully augmented by *scripting* or externally-imposing discussion prompts. Moreover, such external prompts may be extracted by participants themselves when attending to the shifting material status of the collaborating task or constructed by them if tools for annotation are provided.

A contemporary emphasis was identified on *the extended or externalising nature of mental life,* whereby cognition is *offloaded* onto designs or tools within the thinking environment. This invites understanding collaborative interaction in terms of a *collaborating mind, one* for which the triad of *long-term memory, working memory, and executive function* can be traced within the various social exchanges of problem solving that is collective. Such exchanges have also been informed by the study of *brainstorming* groups that reveal the more hidden presence of *collaborative inhibition*. Inhibition within joint thinking has been found manifest first, as task disengagement by participants (ranging from elective social loafing to social exclusion), second as the *disruption of memory,* and third as a vulnerability to premature *fixation* on ideas arising early in discussion.

Finally, the foundational nature of collaborating as an act of learning was emphasised by outlining the emergence of a *collaborative disposition* in early life – although this has been rarely explored as a dimension of individual difference or personality. However, it encourages the further study of learning to collaborate as well as collaborating to learn.