Introduction

The main purpose of this monograph is to present the findings of fifteen years of continuous research on a particular postformal form of thought, namely, 'Relational and Contextual Reasoning' (RCR). RCR is particularly helpful when one seeks to co-ordinate two or more competing theories about the same phenomenon or issue. An example of usefully applying RCR would be when one is debating whether to attribute an outstanding athletic or artistic performance to native endowment or to training. RCR will clarify the extent to which the two kinds of explanations are needed, bring out any links between them, and elucidate the respective explanatory potential in the context considered.

Secondary aims of the monograph are (a) to stimulate further study of RCR, (b) to demonstrate its potential for solving particular problems better than other forms of thought, and (c) to encourage use of RCR and its broader application. Given these main and secondary aims, arranging the material in a coherent manner was not obvious, apart from (c), to which Part II is devoted. Considerations (b) were finally moved to a later chapter (Chapter 5), to be presented after the main aim and secondary aim (a) are met.

The research on relational and contextual reasoning to be reported was originally triggered by the following observation. Whereas many adolescents espouse either a religious or a scientific world view when trying to understand what goes on around and inside them, some manage to 'combine' both views in some fashion. The question that intrigued me was, 'How do they do it?' The answer I came to after looking at other possibilities was that those adolescents use relational and contextual reasoning, a term that I adopted after other trials for reasons to be discussed below. Before I fully reached that insight, however, I had first to work my way through theories of reasoning already proposed.

Until the 1970s, Piagetian formal operations were considered by many researchers to be the high end of individual development of reasoning. The label *formal operations* indicates that certain formalisms have been developed by an individual which can be used for solving a class of problems

irrespective of their particular content. Such operations involve a number of aspects, such as exploring possibility space, hypothetico-deductive theory building, and checking a solution for its internal and external logical consistency. As considered here, the exclusive use of formal binary logic constitutes the characteristic core of Piagetian formal operations (but see Labouvie-Vief 1980). This is exemplified by the central system of sixteen binary operations, to which I shall come back in detail in chapter 5.

In the early 1980s, a category of more highly developed thought, called 'postformal operations', became a topic of interest to a small group of psychologists (e.g., C. N. Alexander, P. K. Arlin, Ch. Armon, P. B. Baltes, M. A. Basseches, A. Blasi, J. M. Broughton, M. J. Chandler, M. L. Commons, C. Gilligan, H. Koplowitz, D. Kramer, G. Labouvie-Vief, E. J. Langer, F. A. Richards, J. D. Sinnott). A number of volumes on that subject were published in fairly rapid succession (e.g., Commons, Richards and Armon 1984; Commons, Sinnott, Richards and Armon 1989; Commons, Armon, Kohlberg, Richards, Grotzer and Sinnott 1990; Alexander and Langer 1990). But those publications appear to have dwindled to a trickle (e.g., Sinnott 1998) without having resolved the central issue of the distinguishing characteristics of *postformal* operations and their relations with Piagetian *formal* operations. No consensus currently exists regarding those characteristics and relations. I would argue that insufficient attention is paid to logic in this debate. Postformal operations may in principle share much with Piagetian formal operations, *with the exception* of formal binary logic. In my view, postformal thinking is based on logics different from formal binary logic. For that reason, as will be shown, fully developed RCR, with its specific logic, is postformal.

A further characteristic of postformal thought is suggested by the established use of the word 'post' (as in *ex post factum*) implying that *fully developed* postformal thinking arises *after* the Piagetian formal operations are mastered. This, however, does not exclude a development of *less developed* stages of various other thought forms *in parallel* with Piagetian stages.

I bring to this work thirty years of experience of research in physics and engineering, together with seventeen years in social science, principally psychology. With this background, it is perhaps not surprising that philosopher physicist Niels Bohr came to my mind when I came across the adolescents who 'combined' religious and scientific world views. Among other issues, Bohr discussed the paradox of the wave-like and particle-like behaviour of light in terms of *complementarity* – that these context-dependent behaviours do not contradict, much less exclude each other, but instead 'complete' each other, and both pictures are needed for a full explanation in non-mathematical terms. I later became aware of William James's account of complementary phenomena concerning (a) memory

and (b) the stream of thought (Reich 1998). Along with these leads, my own career(s) continually encouraged me to look at things from differing points of view and then to work towards a coherent 'story'.

Having become aware of the possible existence of relational and contextual reasoning, I interviewed students and some professional physicists on issues with a 'structure' similar to that of religious vs. scientific world views. For example, I asked them (1) about whether the change from the Romanesque to the Gothic church architecture had spiritual, or economic causes; (2) whether kidney pain is best relieved by surgery, or by drinking a certain type of herb tea; (3) whether the reported crash of a glider was due to naturally explainable causes, or to 'fate' as foretold by the pilot's horoscope. Along with collecting these data, I also studied various types of logic, the debates on the interpretation of quantum theory in physics, as well as various views on the relationships between science and religion/theology. Slowly I came to postulate hypotheses about RCR (initially called 'thinking in terms of complementarity' – Oser and Reich 1987; Reich 1994b), and then worked on clarifying them through empirical work and analyses of the results. After understanding RCR better, I tried to elucidate its 'composition'. My current view is that it shares 'components' with other thought forms, namely, with Piagetian operations, cognitively complex thought, and dialectical as well as analogical thinking. Therefore, I deal here also with these thought forms after having established the distinctness of RCR.

Let me return for a moment to the differing views of religion and science. Is one right and the other wrong? Often both are aiming to 'explain' the same phenomenon, as for example in the case of the origin of the universe. Using a Latin term, the phenomenon to be explained – here the origin of the universe – is designated as the *explanandum*. Whoever works on the explanatory task in the examples given (and in structurally similar ones) and employs relational and contextual reasoning, should keep the competing theories distinct. For instance, when a scientific explanation is (still) missing, to introduce divine action as part of a 'scientific' explanation is not appropriate. Yet, all (partial) theories should be used fully (in their context). This may be referred to as 'both-and' reasoning. When applying (partial) theories, one may find that one or the other theory has more explanatory power under some conditions, and less under others. In other words, one may find that context affects the explanatory efficacy of a partial theory.

Fully developed relational and contextual reasoning will elucidate the *relations* the partial theories have with the explanandum and with each other as well as the details of the *context* dependence. These relationships involve a trivalent logic: two statements about the same explanandum are

either *compatible* (both true concurrently), *incompatible* (never *both* true 'simultaneously') or *noncompatible* (not compatible simultaneously, but one is 'true' in one context respectively at one point in time, the other in a different context or at a different time).

I employ both the terms 'complementary' and 'complementarist' in this monograph. The distinction between the two terms as I use them here is as follows. *Complementary* merely indicates that the various parts, aspects, activities, etc. 'complete' each other, yet they are inherently independent. By contrast, *complementarist* refers to aspects, states, activities, events, views, explanations, etc. which are complementary *and* intertwined, that is inseparable because intrinsically linked (= entanglement as described in quantum physics by Heisenberg's principle of indeterminacy). Examples of the latter would be native endowment and the efforts to produce fruits of practising an art or skill, or the wave-like and the particle-like nature of light. As these example and others show, as a rule the links are not of the cause–effect type but of other types. A given link may be one of 'kinship', of information transfer, of symbiosis, of mutual limitation, and so on.

The appeal of studying RCR and using it appropriately goes beyond purely academic intellectual interest. As one looks around, examples abound where *either/or* thinking (rather than *both-and* reasoning) has undesirable consequences. I would argue that rigid adherence to either/or thinking has impeded the full realisation of the potential of psychology, education and religion, among other fields, and has hindered better resolutions of societal problems like fighting illicit use of narcotics. In these and other comparable cases, RCR offers a method or a pathway toward more encompassing and fruitful results. In sum, RCR is not needed for solving crossword puzzles nor similar, conceptually simple tasks having just one well-defined solution. Rather, it helps in dealing with highly complex, often controversial problems of the kind just indicated. How does RCR help? RCR helps one to analyse the various aspects of a problem and their 'internal' relationships as well as the role of the context and thence to bring out the respective dominant explanation. Doing so contributes to developing the horizons of the mind. This comes about in particular because – where applicable – the use of the 'structural' trivalent RCR logic frees one from the limitations of formal binary logic. This may also permit one to resolve cognitive dissonances or even conflicts.

Once a teacher grasps the nature of RCR and its developmental logic he or she can stimulate RCR in the classroom step by step. In particular, the teacher can further students' ability to differentiate and to integrate statements about what is or might be the case, and can help students to become conscious of different types of logic used in establishing and connecting statements.

Urged on years ago by colleagues and one editor of a leading professional journal to publish this work as a monograph, I deferred doing so until the conceptual basis of RCR was sufficiently clarified, the empirical data well established, and my experience with applying RCR sufficiently promising, particularly in a classroom setting. I am fairly confident that those criteria have now been met. Given RCR's potentially wide-ranging use, I have written the present volume, in particular Part II, with an audience in mind comprising not merely experts or students of developmental psychology, psychology of education, and cognitive science, but also of interested persons from other fields for whom RCR might be relevant and helpful in practice.

A brief discussion of the style of my presentation may be appropriate at this point. Let me begin by citing two exemplars of what I aspire to do in writing this monograph. The first is René Descartes whose 'Discourse on Method' was written in a style that itself illustrated the discourse's content: his writing was systematic, formal, analytic. The second model is Søren A. Kierkegaard, the Danish philosopher theologian, who documented his revolt against the formal, petrified Church of his day. His writing on that subject is unsystematic, aphoristic, sometimes even disjointed.[1] In the same vein, I have attempted to write this monograph in such a way that it expresses RCR stylistically as well as thematically. While the thematic treatment of RCR is fairly obvious, my stylistic demonstration of RCR may require a further word of explanation.

The most significant choice a writer may face, apart from the relative formality of his or her style, is whether to proceed *deductively* after having presented the main thesis 'up front' (risking mental overload of the reader), or *inductively,* presenting the arguments one by one and the resulting thesis as conclusion (risking losing the reader on the way because it is not clear where one is going). In this work exploring RCR, I alternate between partial deduction and partial induction in an effort to emphasise the both-and importance of the two methods for gaining insight. In other words I attempt to make full use of both methods in a complementarist

[1] For persons deeply knowledgeable about the Qur'an (which I am not), the style of the holy book of Islam (in Arabic) is another example of a match between content and style: the style is said to express both the sweetness of city dwellers' sedentary placidity and the forcefulness of Bedouins' migrating roughness; the rhythm of the syllables echoes that of both prose and poetry – the pauses, while different from those in either prose or poetry, exhibit a harmonious and rhythmic symmetry; the words chosen are neither trivial nor overly rare – they are the expression of an admirable nobility; the sentences are phrased in such a way that the smallest number of words renders thoughts of extreme richness; intellect and feelings/emotions are brought in 'together' in such a way that the narration, arguments, doctrines, laws, and moral principles are both intellectually convincing and emotionally engaging (Schimmel 1991, p. 11, quoting an Egyptian scholar; translation from German by K.H.R. as throughout this monograph).

or linked manner, to illustrate how RCR furthers understanding through iterated changes of the viewpoint.

Finally, a caveat: this monograph is not necessarily a fascinating read; in fact, some readers may need extra motivation to keep reading. One of the difficulties with RCR is its 'invisibility', which is comparable to that of scaffolding: when the building or the renovation is done, almost no trace is left of the scaffolding. Similarly, once RCR has done its work and a solution to the given problem has been found, there is mostly no trace left of how the solution came to be found. To use another rubric, one may compare RCR with the number zero (without claiming for RCR the importance of the zero). Peter Bernstein (1998, pp. 32–3) wrote:

> The concept of zero was difficult to grasp for people who had used counting only to keep track of the number of animals killed or the numbers of days passed or the number of units travelled. Zero had nothing to do with what counting was in that sense. As the twentieth-century English philosopher Alfred North Whitehead put it, 'The point about zero is that we do not need to use it in the operation of daily life. No one goes out to buy zero fish. It is in a way the most civilised of all the cardinals, and its use is forced on us by the needs of cultivated modes of thought.'

Similarly, millions live their lives without having heard of relational and contextual reasoning, and without ever using it. My claim is that, were they to use RCR, they would better their chances for improving personal relationships, tackling complex social problems such as getting people to follow good health habits, and dealing more effectively with social and political situations in strife-torn areas such as Northern Ireland, the Balkans, the Middle East, and elsewhere.

There is another possible reason for finding this volume off-putting. Many of us egotistically think that anything we say is both complete and consistent (a violation of Gödel's theorem, by the way), and therefore incorruptible, unchangeable, and not to be questioned. And now comes an author who potentially challenges that view. How does he have the nerve to do that? While understanding such a reaction, I still hope that for serious thinkers, researchers and scholars, the considerations presented here together with the empirical data and their interpretation should open minds to the parameters of organised thought.

Some readers may find that I argue like someone for whom everything becomes a nail because I have a hammer in my hands: indeed, I do use relational and contextual reasoning in many different situations, under widely varying circumstances, and in differing modes, for instance to obtain a result of psychological research, to formulate a hypothesis or a desideratum, or to enable a retroduction.

Although my understanding has reached a level which makes communication of the results reasonable, I do not claim that this volume constitutes the final word on the issues discussed. Rather, I present something to think about, to be explored jointly, this in the hope that others will also contribute to the progress of RCR and its applications.

The organisation of the volume is as follows. Chapter 1 presents fully developed RCR in a basic way so that the sequel becomes understandable. It includes a *structural* analysis of RCR in terms of elementary operations, conjunctive operations, composite operations, and complete forms of thought. Chapter 2 discusses background knowledge needed for understanding the *development* of RCR: the general ontogenetic development from the child's searching to understand the world to the adolescent's argumentative description to the mature adult's balanced views which imply an awareness of the power but also of the limitations of the human mind. Piaget's concept of *intra-inter-trans*, the logic of RCR development, is introduced at that point. Chapter 3 deals with the philosophy of knowledge adopted, and the theoretical underpinnings of RCR. Chapter 4 reports the basic empirical data. Chapter 5 discusses the other thought forms of concern (Piagetian logico-mathematical thinking, cognitively complex thought, dialectical as well as analogical thinking), and expounds on the need to match the type of thought that one uses in analysing and solving a problem to the structure of the problem itself in order to obtain best results. The reason to choose just these thought forms is twofold: on the one hand, as already mentioned, those forms share 'components' with RCR. On the other hand, due to their difference in characteristics and 'performance', they underline the fact that the choice of an appropriate thought form matters. For both reasons they need to be known in their own right, not just as contrasts to RCR.

Part II, that is Chapters 6 through 11, discusses applications of RCR. My conclusions are presented in Chapter 12; the visions of Reginald Victor Jones and of Daniel Goeudevert complete that last chapter. Appendix 1 and Appendix 2 deal with technicalities of RCR interviews and their scoring, respectively. Part II can be read without first reading Part I, but understanding Part II fully might be easier *after* reading Part I.

Part I

The Theory of Relational and Contextual Reasoning (RCR) and its Empirical Study

1 Introduction

The object of this chapter is, first, to formulate a few caveats in order to lessen the risk of misunderstandings and disappointments, then to delimit the domain to be discussed, and above all, to lay the groundwork for subsequent considerations on Relational and Contextual Reasoning (RCR). This includes the basic nature of RCR, and the meaning of *relational*, *contextual* and *reasoning*, RCR's underlying logic, its components and internal structure, and its status as postformal theory. There follows an empirical finding as an illustration of the principles set out so far. Finally, other forms of relational thinking and their importance for the present study are discussed before briefly summing up the chapter.

Caveats

No overarching grand theory exists of everything concerning psychological development of humans.[1] Clearly, each of us often (a) perceives, (b) feels, (c) reasons, (d) plans, and (e) acts in an interrelated manner, and not only in mundane affairs of daily life. Yet, present psychological theories mainly deal with only one of the aspects (a) to (e) (or any other, like motivation, e.g., Reiss and Havercamp 1998); this despite their proponents' awareness of the artificiality of such an isolating procedure. This work is no exception in that regard.

It is neither a new nor a contested claim that thought and emotion are 'inseparably' linked (e.g., Piaget 1954/1981; Bearison and Zimilis 1986; Cacioppo and Gardner 1999, pp. 194–6). Nevertheless, emotions are very largely neglected here. Cognition (perceiving, appraising, understanding, reasoning, judging, remembering, imagining, etc.) and its development, the general subject matter of this work, is complicated enough. For that reason, I further restricted this work to the development of cognitive thought processes.

[1] I write this notwithstanding Wilber's (2000) *A theory of everything*, which is more an eclectic vision than an established theory. For the history and prospects of such a theory in physics – a culturally relative priority – see, e.g., Glashow 1980; Greene 1999; Weinberg 1992.

Likewise, it seems incontrovertible that all thought processes are based on chemico-electric processes in the brain (e.g., Baars 1997; Clark 1997; Damasio 1994, 1999; Edelman 1992; Edelman and Tononi 2000; Gazzaniga 1992; Ramachandran and Blakeslee 1998; Putnam 1999, especially part 2), but again, neurobiology will not be treated here. Interested readers might refer, e.g., to Elman, Bates, Johnson, Karmiloff-Smith, Parisi and Plunkett (1997, pp. 2–4, 239–317, passim) and Johnson (1998).

Nor will there be much discussion of unconscious or preconscious processes although they play an important role in cognition (e.g., *implicit knowledge,* Holyoak and Spellman 1993, pp. 278–90; *the cognitive unconscious,* Lakoff and Johnson1999, pp. 9–15), particularly in its development. As a rule, a person is 'embedded' in the current developmental stage, that is, not fully aware of it and therefore not able to deal with it consciously: the person *is* the stage. When moving to the next stage, the structure of the previous stage becomes the content of the (structurally enlarged) new stage: the person is presently aware of the lower stage characteristics and therefore can *have* it, that is deal with it, differentiate its characteristics (Piaget 1971, §20iv; Kegan 1982, in particular pp. 146–8).[2]

Also, cognitive performance and development are not independent of the social context (e.g., Astin 1998; Monteil and Huguet 1999). While acknowledging that fact, social context is hardly dealt with here in any systematic fashion as far as discussing relational and contextual reasoning proper is concerned. The aim of the work described and discussed in this volume was to carry out enough basic research on RCR to enable its targeted effective application, and then to concentrate on applications in various fields; all the same, social context is included in appropriate cases.

Given these caveats, we now turn to the basic nature of RCR so as to start with at least an elementary understanding of what will become clearer and more detailed in subsequent sections and chapters.

The nature of relational and contextual reasoning

Basic features

Fully developed relational and contextual reasoning (RCR) is a specific thought form which implies that two or more heterogeneous descriptions,

[2] In a different rubric, Gerald Cory (2000) presents a conflict systems neurobehavioural model of the brain: the protoreptilian brain (the evolutionarily oldest) represents the *self-preservation* programming of human behaviour, the mammalian additions (the limbic system, etc.) the affectional programming, and the (typically human) neocortex the executive programming of human behaviour, which notably co-ordinates the activities of the evolutionarily earlier brain parts, especially in case of (instinctive) conflicts between self-interest and other-interests.