THE COGNITION HYPOTHESIS, TASK DESIGN, AND ADULT TASK-BASED LANGUAGE LEARNING

PETER ROBINSON

Aoyama Gakuin University

ABSTRACT

The Cognition Hypothesis of task-based language learning proposes that pedagogic tasks be sequenced for learners largely on the basis of increases in their cognitive complexity so as to increasingly approximate the demands of real-world target tasks. In this paper I describe a framework for operationalizing this proposal that distinguishes between dimensions of tasks that can be manipulated to develop access to an existing L2 knowledge base (such as allowing planning time) and dimensions that can be manipulated to promote greater syntacticization and grammaticization of current interlanguage (such as increasing reasoning demands). Three predictions of the Cognition Hypothesis are that increasing the cognitive demands of tasks along the latter developmental dimensions will (a) push learners to greater accuracy and complexity of L2 production in order to meet the consequently greater functional/communicative demands they place on the learner and (b) promote interaction and heightened attention to and memory for input, so increasing incorporation of forms made salient in the input; and that (c) individual differences in cognitive and affective factors contributing to perceptions of task difficulty will progressively differentiate performance and learning as tasks increase in complexity. I describe results of studies in a componential framework for task design which have examined these issues, providing some support for the predictions made.

INTRODUCTION: THE COGNITION HYPOTHESIS OF ADULT TASK-BASED LANGUAGE DEVELOPMENT

In this paper I describe a rationale for, and illustrate findings consistent with, the Cognition Hypothesis of task-based learning and second language (L2) development (Robinson, 2001a, 2001b, 2002c). I also argue that the framework within which this research has been conducted provides a feasible basis for operationalizing the proposal that pedagogic L2 tasks could be sequenced for learners on the basis of increases in their cognitive complexity, rather than on the basis of linguistic grading and subsequent sequencing of the language input to tasks (Long, 1985, 1998; Long & Crookes, 1992; Robinson, 1996c, 1997c, 1998, 2001c; Robinson, Ting, & Urwin, 1995; Urwin, 1999;

Second Language Studies, 21(2), Spring 2003, pp. 45-105.

Urwin & Robinson, 1999). Since the 1970s, a number of researchers in the areas of second language acquisition and language pedagogy have discussed, and proposed, alternatives to the choice of traditionally defined linguistic units of syllabus content and sequence (e.g., Brinton, Snow, & Wesche, 1989; Crombie, 1985; Johnson, 1996; White, 1988; Widdowson, 1978; Wilkins, 1975; Willis, 1990), some arguing tasks are a valid alternative unit, and that tasks are not simply a medium for delivering a linguistically defined syllabus (Crookes, 1986; Long, 1985, 1998; Long & Crookes, 1992, 1993; Nunan, 1993; Prabhu, 1987; Skehan, 1996 1998). Rather they argue that in a task-based syllabus pedagogic tasks should be developed and sequenced to increasingly approximate the demands of real-world target tasks, with the goal of enabling second language users to succeed in attaining needed lifetime performance objectives (Long, in press; MacNamara, 1996; Norris, Brown, Hudson, & Yoshioka, 1998; Robinson & Ross, 1996). The framework for describing task complexity that I adopt in this paper provides a way of operationalizing such sequencing decisions.

Task-based Language Development and Performance

In this paper I also attempt to show how task-based pedagogy facilitates the cognitive processes involved in second language production (performance) and acquisition (development), and their interrelationship. The distinction between *performance*, and how task demands can differentiate it, and *development*, and how task demands can stimulate it, corresponds largely, I will argue, to two different kinds of dimensions of task demands (see Figure 2 below). These are those which can be manipulated to stimulate *access* to an existing L2 knowledge base (such as allowing planning time) and those which can be manipulated to push learners to go beyond this to meet the demands of a task by *extending* an existing L2 repertoire (such as making increasing demands on the conceptual/linguistic distinctions needed to refer to spatial location, temporality, or causality). The distinction is similar to one made by Bialystok (1991) between the dimensions of control, and analysis, involved in second language learning. While these two performance and developmental axes of task-based learning can be manipulated separately during task design, they are often drawn on simultaneously during real-world performance in an L2, and there are likely to be synergies between them, such that allowing planning time, for example, or designing a task that draws on readily available prior knowledge, frees up attentional and memory resources for allocation to developmental dimensions of tasks, such as articulating reasons, or making increasingly complex reference to time, or space. In this view, the effects of planning time are likely to be differentiated by the other, developmental, dimensions of the task that can accompany planning time, and I make suggestions about how this issue might be addressed in future research.

The framework I describe below also lays a heavy emphasis on the quantity and quality of interaction accompanying increasingly complex task performance, and the shared attention to language that this can facilitate (Tomasello, 1999), as the prompt for L2 learning processes. In relating task-based pedagogy to acquisition processes some have argued that the meaningful language exposure that task work makes available to learners enables unconscious "acquisition" processes (Krashen, 1985) to operate successfully on the comprehensible input tasks can provide (see Prabhu, 1987): language production, and attention to form, are of much less, if any, importance. In contrast, the proposal made here is that task-based learning, sequenced according to the criteria I describe, and others like them, leads to progressively greater attention to, "noticing", and elaborative processing and retention of input (Robinson, 1995b; Schmidt, 1995, 2001); progressively more analysis of the input *and* output occurring during task work (Doughty, 2001; Muranoi, 2000; Pica, 1987; Swain, 1985, 1995), and also progressively greater amounts of *interaction* which in part facilitate those attentional and analytic processes (Long, 1996; Mackey, 1999). That is, I argue both the cognitive processing, *and* interactive consequences of task sequencing decisions are mutually responsible for subsequent task-based language development.

The predictions of the Cognition Hypothesis for second language acquisition processes, which I describe in detail below, are based on related claims in areas of functional/cognitive linguistics, (e.g., Givon, 1985, 1995; Rohdenburg, 1996, 1999; Talmy, 2000; Tomlin, 1990), in L1 developmental psychology (e.g., Cromer, 1991; Slobin, 1993), and in SLA research (e.g., Becker & Carroll, 1997; Doughty & Williams, 1998; Perdue, 1993; Schmidt, 1983, 2001). The hypothesis claims that increasing the cognitive demands of tasks contributing to their relative complexity along certain dimensions will (a) push learners to greater accuracy and complexity of L2 production in order to meet the consequently greater functional/communicative demands they place on the learner and (b) promote heightened attention to and memory for input, so increasing learning from the input, and incorporation of forms made salient in the input, as well as (c) longer term retention of input; and that (d) performing simple to complex sequences will also lead to automaticity and efficient scheduling of the components of complex L2 task performance.

A Componential Framework for L2 Task Design

While the work on the Cognition Hypothesis described in this paper has as a primary motivating goal the development of feasible sequencing criteria for classroom tasks, it is not limited to this either in explanatory scope or in potential practical application. The Cognition Hypothesis is also important to explore for those concerned to develop equivalent forms of language tests (see e.g., Elder, Iwashita, & Macnamara, 2002; Iwashita, Elder, & Macnamara, 2001; Norris *et al.,* 1998). As Elder, Iwashita, and MacNamara comment, in discussing the framework to be described in this paper, and that of Skehan (1998):

Both Skehan and Robinson claim that their respective models have the potential to reveal the precise nature of the mediation that occurs between any underlying abilities and the way a task is transacted. Such frameworks would appear to hold considerable promise for language testing in so far as they allow us to make predictions, and therefore to select and sequence test tasks according to their difficulty (i.e., the challenge they pose to test candidates… (2002, p. 348).

In the "triadic componential framework" (Robinson, 2001a, 2001b) I have proposed for examining the implications of the Cognition Hypothesis for classroom practice and syllabus design, I distinguish the cognitive demands of pedagogic tasks contributing to differences in their intrinsic *complexity* (e.g., whether the task requires a single step to be performed, or dual, or multiple simultaneous steps, or whether reasoning demands are low or absent, versus high), from the learners' perceptions of task *difficulty*, which are a result of the abilities they bring to the task (e.g., intelligence) as well as affective responses (e.g., anxiety). I distinguish both of these from task *conditions*, which are specified in terms of information flow in classroom participation (e.g., one versus two-way tasks) and in terms of the grouping of participants (e.g., same versus different gender). This triadic componential framework enables the complex classroom learning situation to be analyzed in a manageable way, allowing interactions among these three broad groups of complexity, difficulty, and condition factors to be charted. In what follows I describe first the claims of the Cognition Hypothesis, relating these to previous work in a number of areas. I then des cribe the triadic componential framework for examining task influences on instructed SLA, pointing out where the predictions made within the framework are compatible with, or contrary to, predictions of another theoretical framework for researching instructed task-based SLA (Skehan, 1996, 1998), before summarizing results from recent studies which are in line with some of the predictions of the Cognition Hypothesis.

1. THE COGNITION HYPOTHESIS: PARALLELS IN CHILD AND ADULT LANGUAGE DEVELOPMENT

How is Cromer's (1974) "Cognition Hypothesis" of L1 acquisition—that conceptual, and cognitive development, creates the impetus for language development—relevant to adult task-based L2 development (Robinson 1996c, 1997c, 2001a, 2001b, 2003a) and the pedagogic issue of the grading and sequencing of learning tasks based on differentials in their cognitive demands? I argue that it is, but with an obvious caveat, that Slobin (1993) makes clear. In discussing the parallels between child and adult language development in the emergence of prepositions for marking first topological relations of neighborhood, and containment, and later, axis-based projective relations of between, front/backness, in the European Science Foundation (ESF) project data (see Perdue, 1993b) Slobin (1993, p. 243) comments as follows:

> The parallels, though, cannot be attributed to the same underlying factors. In the case of FLA (first language acquisition) one appeals to cognitive development: the projective notions simply are not available to very young children. But in the case of ALA (adult language acquisition) all of the relevant cognitive machinery is in place. Why, then, should learners have difficulty in discovering the necessary prepositions for spatial relations that they already command in the L1? There are at least two possibilities: (1) adult learners retain a scale of conceptual complexity, based on their own cognitive development, and at first search the TL (target language) for the grammatical marking of those notions which represent some primordial core of basicness or simplicity; and/or (2) these most basic notions are also used with

> relatively greater frequency in the TL…It is likely that speakers, generally, have less recourse to the encoding of complex notions, and that learners are simply reflecting the relative frequency of occurrence of various prepositions in the input…Or it may be that the complex relations are, indeed, communicated above some threshold of frequency, but that learners "gate them out" due to their complexity. In this case cognitive factors play a role in both FLA and ALA, but for different reasons: the complex notions are not available to very young children, while they are available but not accessed in early stages of ALA.

With possibilities (1) and (2) above in mind, I then want to argue that increasing the cognitive demands of pedagogic tasks provides a basis for sequencing pedagogic tasks in a task-based syllabus, since it allows the processing and other *performance demands* of real-world target tasks to be gradually approximated over a course of instruction. I also argue that such sequencing may have important, predictable, effects on *language development* (pushing learners to greater lexical density, grammaticization, and syntacticization), and may also have important effects on *interaction* and the opportunities for learning it can provide (creating the conditions for noticing and uptake of aspects of input made salient through interventions, such as flooding, input enhancement, and recasting). These claims constitute the Cognition Hypothesis of task-based language learning, and rest on a number of assumptions, some of which may turn out not to be necessary, and some of which may turn out not to be true. Eight of these assumptions are described briefly below.

1.1 Child L1 and Adult L2 Development are Fundamentally Different

While there are parallels between them, as described above, child and adult language acquisition differ, in part since adults have no access to the innate knowledge some argue guides L1 and child L2 development (see e.g., Carey & Spelke, 1994; Elman, Bates, Johnson, Karmiloff-Smith, Parisi, & Plunkett, 1996; O'Grady, 2003; White, 2003 for various positions on this issue). Further, many argue innate knowledge of language is increasingly dissipated throughout a Critical Period, or one or more sensitive periods, for language acquisition (Hyltenstam & Abrahamsson, 2003; Johnson & Newport, 1989, 1990; Long, 1990; Scovel, 1988). In addition, adults clearly have more developed (meta)cognitive and (meta)linguistic capacities than children, which they often automatically bring to bear on classroom L2 learning (Bialystok, 1991; Bley-Vroman, 1990; DeKeyser, 2000; Harley & Hart, 2002; Karmiloff-Smith, 1992; Klein, 1989; Newport, 1990).

1.2 The Cognition Hypothesis Cannot Explain Child L1 Development.

A strong form of the cognition hypothesis (Cromer, 1974; cf. Behrens, 2001; Berman, 1987; Slobin, 1973; Weist, Lyytinen, Wysocka, & Atanassova, 1997), that conceptual development is the pace-setter which pushes linguistic development, is unlikely to explain first language (L1) acquisition, given (a) the facts of "delayed language without deviance" (Chapman, 1996, p. 651; Rosenberg, 1982) in children with cognitive deficits such as Down Syndrome (see Bates, Dale, & Thal, 1996; Rondal, 1995); and (b) the more mixed (sometimes delayed, sometimes superior relative to normal controls) performance of children with Williams syndrome (Bates, Dale, & Thal, 1995; Bellugi, Marks, Bihrle, & Sabo, 1988; Cromer, 1988, 1991; Reilly, Klima, & Bellugi, 1991). These findings suggest the likely availability of some form of innate, possibly modular, language knowledge in childhood which is robust in guiding language development in the face of delayed, and ultimately impaired, intellectual development. However, it may be possible to base a rationale for promoting adult task-based "second" language learning on a strong form of the hypothesis, given 1.1 above, and 1.3 below.

1.3 The Cognition Hypothesis Provides a Rationale for Promoting Task-Based L2 Development Through Task Sequencing and Design Decisions

The claim made here (and described in detail in section 2 below) is that it is possible to stage increases in the cognitive demands of language learning tasks which recapitulate the ontogenetic course of conceptual development in childhood, e.g.: (a) from tasks in the *Here-and-Now*, to tasks requiring reference to the *There-and-Then* (see Bronckart & Sinclair, 1973; Cromer, 1974, 1988; Meisel, 1987; Robinson, 1995a; Rahimpour, 1997, 1999; Sachs, 1983); (b) from tasks requiring spatial description that can be completed by establishing and *describing topological relations* to those requiring spatial descriptions that must be completed by establishing and describing *axis-based* relations (see Carassa, Aprigliano, & Geminiani, 2000; Chown, Kaplan, & Kortenkamp, 1995; Cornell, Heth, & Alberts, 1994; Taylor & Tversky, 1996), which themselves emerge in the L2 in the order vertical axis< lateral axis< sagittal axis (see Becker & Carroll, 1997; Perdue, 1993b); or (c) from tasks requiring simple narrative description of *successive actions*, with *no causal reasoning* to establish event relations, to those requiring narrative description of *simultaneous actions*, and *"theory of mind" reasoning* about participants' mental states (see Baron-Cohen, 1995; Bartsch & Wellman, 1995; Berman & Slobin, 1994; Gopnik & Wellman, 1994; Lee & Rescorla, 2002; Malle, 2002; Niwa, 2000; Robinson, 2000; Wellman, 1990; Wimmer & Perner, 1983).

1.4 There is a Natural Order for Sequencing L2 Task Demands

Such staged increases in the cognitive demands of tasks may therefore provide the learner with optimal, ontogenetically natural, contexts for making the form-function mappings necessary to L2 development. This would be a way of operationalizing sequencing decisions in line with Slobin's first possibility for explaining adult-child parallels in language development cited above, i.e., "adult learners retain a scale of conceptual complexity, based on their own cognitive development, and at first search the TL for the grammatical marking of those notions which represent some primordial core of basicness or simplicity" (1993, p. 293). I discuss this possibility in more detail in section 2.2 of this paper, and describe the results of studies that have operationalized such sequencing decisions, and studied their effects on L2 production and learning, in section 3 below.

1.5 Individual Differences Affect Adult L2 Task Performance

Individual differences in the rate and level of ultimate attainment achieved during L2 development are clearly more apparent than they are in L1 development. An assumption of the Cognition Hypothesis is that all adult L2 learning is subject to variation attributable, at least in part, to differences in the cognitive resources (attentional allocation and control, and memory capacity) that learners bring to the learning context (see Robinson 1995b, 1995c, 1997a, 2001c, 2002a, 2002b). This assumption is at odds with claims by Krashen (1982), and Reber (1989; Reber & Allen, 2000; Reber, Walkenfield, & Hernstadt, 1991) that "acquisition" and "implicit" learning respectively are unconscious processes that are impervious to individual differences in cognitive capacities. The Cognition Hypothesis of task-based learning further assumes that individual differences in cognitive resources, and the abilities, such as aptitude, that they contribute to should increasingly differentiate performance and learning as tasks increase in complexity, as they have been found to do in other areas of instructed adult learning (see e.g., Ackerman, Kyllonen, & Roberts, 1999; Fleishman & Quaintance, 1984, Ch.7; and Knorr & Neubauer, 1996; Snow, Kyllonen, & Marshalek, 1984; Tucker & Warr, 1996, for related findings).

1. 6 Task Complexity Affects L2 Use, and Also L2 Learning

The Cognition Hypothesis makes predictions about the effects of task complexity on the quality of language performance, and comprehension, and also about the effects on learning, in the sense of progress through developmental sequences and stages, and in the sense of uptake of new language input during task performance. Bearing in mind the variation attributable to individual differences in the availability of cognitive resources, I argue that increasing the cognitive demands of L2 tasks (Niwa, 2000; Robinson 1995a, 2001a, 2001b, 2003a) will in general (i.e., when research uses group comparisons of performance on tasks at different levels of complexity) lead to greater functional differentiation of learner language use (Givon, 1985; Sato, 1990; Newton & Kennedy, 1996), and greater attention to output, and depth of processing of input, with the consequences of (a) speeding development through stages of interlanguage (Mackey, 1999; Perdue, 1993a) and of (b) increasing the likelihood of attending to, and noticing aspects of input presented to learners during task activities (Schmidt, 1995, 2001), and retaining these for subsequent use.

1.7 Task Complexity Affects Uptake Induced by Feedback, and Focus on Form

In addition to development of form-function mappings, facilitated by using language to meet increasingly complex task demands, in the proposal made here for task-based learning, selective attention to purely formal, functionally redundant features of the L2 will additionally be necessary. That is, in addition to the demands tasks make on processing meaningful semantic and conceptual communicative content, Focus on Form (FonF), i.e., selective attention to such forms in communicative context (Doughty & Williams, 1998; Long, 1991, 1996; Long & Robinson, 1998; Muranoi, 2000; Philp, 2003), will also be necessary, and this will be most effective in facilitating noticing of input made salient on complex tasks, since these require greater mental and communicative effort, depth of processing, and so greater attentional and memory resource allocation to input, than simpler tasks. While, with the exception of one study described in detail in section 3, there are no SLA findings to date to support this latter claim, there are findings in line with the prediction from non-SLA research. Mascha (2001) found precisely this interaction of feedback, learning, and task complexity in her study of the effect of *expert system use* on procedural knowledge acquisition; feedback facilitated procedural learning on complex, but not simple, tasks. Nembhard (2000) also found more learning, and less forgetting occurred on complex, versus simple, (*textile assembly)* tasks, as did Schneider, Healy, and Bourne (2002) in their study of retention during vocabulary learning tasks.

A further justification for this claim is the fact that more cognitively complex oral interactive tasks simply lead to greater quantities of interaction and modified repetitions. Only two studies have shown this directly, (Robinson, 2001a, 2003), but these findings are also broadly compatible with Allwood's observation (in Perdue, 1993a, pp. 136-141) that the proportion of on-task feedback-containing-utterances (FBUs) in the ESF project, and also feedback words (FBWs) decreases over time as learners increase in proficiency. At any one point in time, therefore, more complex tasks making greater demands on proficiency should elicit more of such feedback relative to simpler versions, and such feedback provides an interactive context (e.g., through use of clarification requests, confirmation checks, and responses to them) for reactive Focus on Form techniques, such as recasting (see Doughty, 2001; Doughty & Williams, 1998).

1.8 Simple to Complex Task Sequencing Leads to Efficient Scheduling and Automatization of L2 Task Components During Task Performance

Finally, the Cognition Hypothesis predicts that sequencing tasks from simple to complex creates the optimal conditions for practice (Robinson, in preparation a) leading to gains in automaticity (DeKeyser, 2001), since it facilitates the executive processes of *scheduling,* and *coordinating* the component demands of complex tasks (see Jonides, 1995; Neumann, 1987; Rubinstein, Meyer, & Evans, 2000; Sanders, 1998; Sarno & Wickens, 1995). Some ways in which this can be facilitated are by progressively withdrawing planning time over task cycles, and increasing the number of subtasks to be concurrently performed, and gradually withdrawing the relevant prior knowledge a learner can draw on in performing tasks. In this view, simple tasks can be seen as "scaled worlds" "which preserve certain functional relationships of a complex task environment while paring away others" (Ehret, Gray, & Kirschenbaum, 2000, p. 8), enabling each to be practiced separately, before being combined in complex task performance under real-world conditions.

In this paper, I want to examine the evidence for some of these predictions (points 1.3 to 1.6 above), pointing out the important influence of two moderator variables on learning from Focus on Form during task-based interaction. These are (a) the relative complexity (i.e., attentional, memory, reasoning and conceptual demands) of interactive tasks, and (b) individual differences in learner resources, as measured, for example, by aptitude or working memory tests. Taken together, Focus on Form research, along with research into the design characteristics of tasks that contribute to their complexity (Robinson, 1995a, 2001a, 2001b), and individual differences in the cognitive resources learners bring to task performance (Robinson, 1995b, 1997a, 2001c, 2002a, 2002b, 2003a, 2003b), define an agenda for task-based learning research with direct pedagogic implications at the level of materials design, classroom delivery, and syllabus sequencing.

2. OPERATIONALIZING TASK COMPLEXITY

2.1 Task Complexity, Task Difficulty, and Task Conditions

While real-world L2 task performance (the intended ability which task-based pedagogy aims to induce) is clearly multicomponential, in developing this ability task designers have inevitably to stage increases in the complexity of pedagogic tasks, and in doing so they must make use of some operational framework for selectively adjusting and increasing the demands of tasks to gradually approximate real-world performance conditions. Figure 1 is a basic illustration of an elaborate triad of components (Robinson, in preparation b) that can be used as such a framework, and serves to make the important distinction between complexity, difficulty and condition. Task *complexity* refers to the intrinsic cognitive demands of the task, and can be manipulated during task design along the dimensions illustrated in Figure 1. Just as simple addition is less cognitively demanding than calculus, so a task requiring the speaker to give directions from point A to B on a small map, with few well distinguished landmarks, which the speaker and listener have prior knowledge of, will be simpler than giving the same directions using a large map, with many landmarks, covering a previously unknown area. Task complexity, then, will contribute to within-participant variance in performing two tasks that differ along the dimensions illustrated to the left of Figure 1.

Task complexity (cognitive factors)	**Task conditions** (interactional factors)	**Task difficulty** (learner factors)
a) resource-directing e.g., +/- few elements +/- Here-and-Now +/- no reasoning demands	**a) participation variables** e.g., open/closed one-way/two-way convergent/divergent	**a) affective variables** e.g., motivation anxiety confidence
b) resource-dispersing e.g., +/- planning +/- single task +/- prior knowledge	**b) participant variables** e.g., gender familiarity power/solidarity	**b) ability variables** e.g., aptitude working memory intelligence
Sequencing criteria Prospective decisions about task units		**Methodological** influences On-line decisions about pairs and groups

Figure 1. Task complexity, condition, and difficulty (from Robinson, 2001a)

In contrast, task *difficulty* concerns learners' perceptions of the demands of the task, and is dependent on differences between learners in the cognitive factors (e.g., aptitude, working memory) and affective variables (e.g., anxiety, confidence) that distinguish them from one another (see Robinson, 2001b; Spilsbury, Stankov, & Roberts, 1990). So a learner high in aptitude, or working memory capacity, may find the same task to be easier than a learner low in both of these, thus contributing to between-participant variation in task performance and learning. Thirdly, task *conditions* concerns the interactive demands of task performance, such as participation factors, e.g., whether the information is equally distributed (a two-way task) or is passed from one person to another (a one-way task); and participant factors, e.g., whether the task participants are previously familiar with each other, or not, or the same versus different gender.

Of these three sets of factors I argue complexity differentials should be the major basis for proactive pedagogic task sequencing in task-based approaches to syllabus design. Unlike some (Candlin, 1987; Nunan, 1989) I argue difficulty variables, such as motivation to perform, and anxiety about performing tasks are often impossible to diagnose in advance of task performance, and that similarly the communicative stress (Candlin, 1987; Skehan, 1998) induced by a task's demands is also unquantifiable ahead of task performance, and is moreover likely variably affected by other task condition factors, such as the degree of familiarity of task participants, their relative proficiency level, etc. For these reasons I argue affective "difficulty" factors are not "feasible" bases for *proactive* decision making about task sequencing, although they are extremely important to monitor *in situ*, and may contribute to on-line changes in *a priori* sequencing decisions on occasion.

In contrast, a number of task "condition" factors described in Figure 1, *can* be manipulated in advance of task performance during task design (see Pica, Kanagy, & Falodun, 1993, for review) and some have argued that task sequencing should be based, at least in part, on differences in such task conditions (e.g., from closed, information gap, to open opinion gap tasks, see Prabhu, 1987). However, choice of task conditions, in terms of participation factors (direction of information flow or the nature of the solution to a task), in the approach taken here, will largely be determined by fidelity to the target task conditions identified in the needs analysis (see Long, 1998), and which the pedagogic classroom tasks based on them will consequently replicate each time they are performed. For this reason I argue task conditions should be specified *a priori*, and then held constant each time progressively more cognitively complex versions are attempted in L2 classrooms.

2.2 Developmental and Performative Dimensions of Task Complexity

Figure 1 also makes a distinction between two categories of the dimensions of task complexity, *resource-directing* dimensions, and *resource-dispersing* dimensions. The former dimensions are those in which the demands on language use made by increases in task complexity can be met by specific aspects of the linguistic system. For example, tasks which differ along the Here-and-Now versus There-and-Then dimension clearly require the learner to distinguish between the temporality of reference (present versus past), and to use distinct deictic expressions (*this*, *that, here*, *there*) to indicate immediately present, versus absent objects. As Cromer (1974) and others have noted, this sequence of conceptual and linguistic development takes place in child L1 acquisition of English, and a similar sequence of linguistic development has been observed in L2 acquisition, as well (Meisel, 1987). Similarly, tasks which require no reasoning and simple transmission of facts, compared to tasks which require the speaker to justify beliefs, and support interpretations by giving reasons, also require, in the latter case, expressions, such as logical subordinators (*so*, *because*, *therefore*, etc.), and in the case of reasoning about other people's intentions and beliefs, use of psychological, cognitive state verbs (e.g., *know*, *believe*, *suppose*, *think*) which themselves require complex syntactic complementation. This sequence of conceptual and linguistic development too, has been observed in child language acquisition, with psychological state terms emerging in the order, physiological, emotional, and desire terms, and then later, cognitive state terms (Lee & Rescorla, 2002; Shatz, Wellman, & Silber, 1983), and the later emergence of cognitive state terms (and the complex predication that accompanies them) is associated with the child's development of a "theory of mind" (Baron-Cohen, 1995; Bartsch & Wellman, 1995; Wellman, 1990).

Similarly, in developing the ability to navigate through a complex spatial location, containing many elements, it has been observed that in the first phase of mapping, a basic topological network of landmarks is constructed and referred to, in which a landmark is connected only with the landmarks that can be seen from it, and is thus in a sense an egocentric, ground level *route map* (Carassa *et al*., 2000; Cornell, *et al*., 1994; Taylor & Tversky, 1996). Subsequently, *survey maps* are developed and used in navigation and reference to location, that allow the speaker to take multiple perspectives on a location, using axis-based relations of betweeness, and front/backness, and this same sequence of development has been documented in the emergence of reference to spatial location in second language acquisition (Becker & Carroll, 1997).

In each of these three cases, then, which correspond to the three *resource-directing* dimensions of task complexity in Figure 1, I would argue that increasing task complexity during L2 performance involves some recapitulation of a sequence of cognitive development in childhood, and that the increasingly complex demands that tasks impose along these dimensions can be met by use of specific aspects of the second language which code these “familiar” adult concepts. Bearing in mind the speculation of Slobin cited earlier, that “adult learners retain a scale of conceptual complexity, based on their own cognitive development, and at first search the TL (target language) for the grammatical marking of those notions which represent some primordial core of basicness or simplicity” (Slobin, 1993, p. 243), then sequencing cognitive demands from simple to complex along these dimensions would be complementary to adult learners own initial dispositions, and also helpful in prompting them to move beyond them.

In contrast, increasing task complexity along the *resource-dispersing* dimensions in Figure 1 does not direct learners to any particular aspects of language code which can be used to meet the additional task demands. Taking planning time, or relevant prior knowledge away, or increasing the number of tasks that have to be performed simultaneously, simply disperses attentional resources. However, increased complexity along these resource-dispersing dimensions is important, since it serves to simulate the processing conditions under which real time language is often used (on the spot, in novel unexpected circumstances, while doing something else), and practice along them could be argued to facilitate *real-time access* to an already established and developing repertoire of language, rather than to facilitate new form-function and conceptual mappings in the L2 (see 1.8 above and Figure 2).

For these reasons I have argued that predictions about the effects of task complexity along these two kinds of dimensions should be very different. Increasing complexity along resource-directing dimensions can be expected to lead the learner to attempt to map the increasing conceptual/functional requirements of tasks onto speech, in such a way as to affect fluency negatively, but, in selected domains, to facilitate the development of increased accuracy and complexity of production (see section 3 below). In contrast, increasing complexity along resource-dispersing dimensions can be expected to affect fluency, as well as accuracy and complexity, negatively, since it creates problems for learners attempting to access their current repertoire of L2 knowledge. Further, the effects of task complexity on speech along complex resource-directing dimensions can be expected to be stronger when the task is simultaneously simpler along one or more resource-dispersing dimensions, compared to when it is complex along both kinds of dimensions.

+ many elements + reasoning + There-and Then + planning + prior knowledge + single task **3** **LOW PERFORMATIVE AND HIGH DEVELOPMENTAL COMPLEXITY**	+ many elements + reasoning + There-and Then - planning -prior knowledge - single task **4** **HIGH PERFORMATIVE AND HIGH DEVELOPMENTAL COMPLEXITY**
+ few elements + no reasoning + Here-and-Now + planning + prior knowledge + single task **1** **LOW PERFORMATIVE AND LOW DEVELOPMENTAL COMPLEXITY**	+ few elements + no reasoning + Here-and-Now - planning - prior knowledge - single task **2** **HIGH PERFORMATIVE AND LOW DEVELOPMENTAL COMPLEXITY**

Figure 2. Resource-directing (developmental) and resource-dispersing (performative) dimensions of complexity and their implications for task sequencing

These issues also have implications for task sequencing, which can not be dealt with in great detail here, save that to note they suggest that tasks should first be made complex along resource-dispersing dimensions (e.g., from planning, to no planning time, or from single to dual task), while being kept simple along resource-directing dimensions (e.g., Here-and-Now, no reasoning, and few elements to distinguish and refer to) so as to ensure optimal conditions for *accessing* and proceduralising current and basic interlanguage resources. Subsequently, to increase new form-function and conceptual mappings and more complex syntacticized language, tasks should be made complex along resource-directing dimensions. This suggested sequence is illustrated in Figure 3 (see Robinson, in preparation b, for further discussion).

2.3 Manipulating Task Complexity

The dimensions of task complexity just discussed, and illustrated in Figures 1 and 2, can be manipulated in the way shown in Figure 3, such that pedagogic tasks, i.e., the units of classroom activity, can be performed in an order that gradually approximates the demands of real-world, target task performance. For example, a task which requires a speaker to give directions to another person using a map could initially be designed so the speaker has planning time, has the route marked on the map, and where the map is of a small, mutually known area. This would correspond to version 1 of the task in Figure 3. The most complex, “real-world”, version 5, would involve no planning time, no route marked on the map, and a large area of an unfamiliar location -- as when a passenger in a car gives directions to the driver about how to find a hotel neither of them have been to before as they drive through an unknown city. In this view, initially simple pedagogic versions of real-world target-tasks are progressively complexified on the relevant component dimensions so as to approach the full performative, and conceptual complexity of real-world language use. The sequences of pedagogic versions of target-tasks operationalized in this way would be specified in the syllabus and form the basis of sequences of classroom activity (see Long, 1998; Long & Crookes, 1992; Robinson 1998, 2001c, in preparation b, for extended discussion of the details of task-based syllabus design and the identification of target, and pedagogic tasks).

Map Task Versions and Pedagogic Sequence

Dimensions of complexity	**Simple 1**	**2**	**3**	**4**	**Complex 5**
planning time (before speaking)	+	-	-	-	-
single task (route marked)	+	+	-	-	-
prior knowledge (a familiar area)	+	+	+	-	-

few elements (a small area)	+	+	+	+	-
	(**simplified** data/map)				(**authentic** data/map)

Figure 3. Increasingly cognitively complex versions of a map task (adapted from Robinson, 2001a)

3. THREE PROPOSALS FOR THE EFFECTS OF TASK COMPLEXITY ON PRODUCTION AND LEARNING

In my introduction to this paper I referred to a number of predictions of the Cognition Hypothesis of task-based learning, and below I offer some motivation for three them from SLA and other research, before offering some support for the specific predictions made from a survey of recent studies in the framework I have described. These predictions are that task complexity affects second language *production*, as well as *interaction*, uptake and *incorporation* into learner production of new information available on task, and finally that *individual differences* between learners in cognitive and affective factors are particularly influential on complex, as opposed to simpler, task performance.

3.1 Task Complexity Affects Language Production

Most recent task-based L2 research has been concerned with the effects of tasks on the quality of learner production (e.g., Bygate, 1996, 2001; Robinson, 1995a; Skehan, 1998; Skehan & Foster, 2001). The claims about the effects of task complexity on the accuracy and syntactic complexity of L2 production illustrated in Figure 4 are based on similar claims by Givon that "greater structural complexity tends to accompany greater functional complexity in syntax" (1985, p. 1021), and by Perdue that "acquisition is pushed by the communicative tasks of the discourse activities which the learner takes part in" (1993a, p. 53). In this view, increasing the functional/cognitive demands of tasks has the potential to affect the way L2 production is syntacticized, i.e., to cause a shift from the pragmatic to syntactic mode (Givon, 1985, 1995, 2002) or to push development beyond the "basic learner variety" (Klein & Perdue, 1992, 1997). Complementary to these claims, I also argue, following Rohdenburg (1996, 1998) that "in the case of more or less explicit grammatical (or lexico-grammatical) options, the more explicit one(s) will tend to be preferred in cognitively more complex environments" (Rohdenburg, 2002, p. 80), such as those likely to result from complex oral task performance along the cognitive *resource-directing* dimensions described in Figures 1 and 2 (see study 1 and 2 below, and Robinson, 1995a, and 2001b).

I also argue that increasing the complexity of the conceptual and functional demands of tasks is likely to draw learner attention to the ways in which the L1 and the L2 may differentially *grammaticize* conceptual notions (Talmy, 2000), and so have positive effects on L2 accuracy of production. Talmy, on the basis of extensive crosslinguistic analysis of grammaticizable notions in language, distinguishes between two, universal subsystems of meaning-bearing forms in language; the open-class lexical, and the closed-class grammatical, subsystems. Talmy notes that whereas the meanings that open-class forms (e.g., nouns, verbs and adjectives) can express are very wide, the meanings of closed-class items (e.g., verbal inflections, prepositions and determiners) are highly constrained, both with respect to the conceptual domain they can refer to, and as to member notions within any domain. For example, grammaticizable conceptual domains typically marked on verbs include tense, aspect and person, but never spatial setting (indoors, outside), or speaker's state of mind (bored, interested. etc.). And whereas many languages have closed-class forms indicating the number of a noun referent, *within* that conceptual domain, forms can refer to notions such as singular, dual or plural, but never to even, odd, a dozen, etc. While this constrained inventory of possible form-meaning mappings may reduce the hypothesis space that L2 learners work within in grammaticizing their L2, languages differ in the extent to which they grammaticize forms within this inventory of conceptual domains, and individual member notions within those domains. In learning an L2 the privileged relationships between closed-class, concept structuring words and the concepts of, for example, time, and motion, that they grammaticize has to be made again, with often different conceptual distinctions being grammaticized in the L2, and others abandoned. Gradually increasing the cognitive and conceptual demands of L2 tasks therefore has the potential to selectively draw learners' attention to those areas of overlap, and divergence, from the concept-structuring function of closed-class items in the L1 versus the L2, leading to gains in accurate grammaticization.

The problem of how to choose and sequence tasks to elicit the developing complexity of learner language has been addressed by those working within the ESF project, which has charted the development of naturalistic SLA by adult learners of a variety of source (L1) and target (L2) languages. In discussing how learners select from the various linguistic means of achieving a communicative function, such as reference to past in English (e.g., using a fronted temporal adverbial, such as *yesterday*, *last yea*r, or past tense marking on verbs, or both), and the problem of specifying tasks to elicit evidence of development in this area, Perdue comments that:

> if the learner by virtue of his first language competence knows how to apply such functions, what he has to learn is how to express them in the language being acquired. The analyst then sets out to identify which of the various possibilities the learner chooses first, and how the balance is shifted from certain elementary devices to more complex ones until he (possibly) disposes of the full repertoire offered by the target language. If the analyst sets out to study the expression of such functions, it follows that the research areas…must correspond to tasks the learner has to find the means to perform. (1993a, pp. 54-55)

Monologic tasks	
simple	**complex**
+ fluency, - complexity, - accuracy	- fluency, + accuracy, +complexity
Interactive tasks	
simple	**complex**
+ fluency, - accuracy, - comprehension checks/ - clarification requests	- fluency, + accuracy, + comprehension checks/ + clarification requests

Figure 4. Task complexity and monologic/interactive task production along resource – directing (not resource-dispersing) dimensions

It follows too, that such a balance may be shifted by pedagogic interventions which manipulate the design characteristics of tasks, and the sequence in which they are presented to learners, so as to increase their functional and conceptual demands, so prompting learners to change from the use of "elementary devices to more complex ones".

The claims made above about the effects of task complexity along *resource-directing* dimensions differ in some ways from those of Skehan (1998), who argues that accuracy and complexity are in competition for resources, and that task complexity degrades fluency, accuracy, *and* complexity. I argue task complexity degrades only fluency, but that on complex *interactive* tasks, the greater interaction and interlocutor participation that complex task work encourages may mitigate attempts to produce complex syntax in response to the conceptual and functional demands of the task. However, in *monologic* production, complex tasks should also result in more complex syntax, along resource-directing dimensions. In contrast, along *resource-dispersing* dimensions, as mentioned previously, I would agree largely with Skehan, that if task manipulations deplete available time, and available relevant schematic knowledge and increase demands on task-switching and scheduling mechanisms (by taking away planning time, prior knowledge, and increasing the number of concurrent tasks) then it should negatively affect all aspects of language production.

3. 2 Task Complexity Affects Language Learning (Noticing, Uptake, and Incorporation)

In addition to the rationale given above for the effects of tasks on language production, I would also argued that greater task complexity along resource-directing (but not necessarily resource-dispersing) dimensions promotes more interaction-driven learning (Robinson, 2001a, 2001b; cf. Long, 1996; Mackey, 1999). Skehan (1998) largely discusses the effects of tasks on production and use, and learning in the sense of analyzing formulaic language (1998). While I agree that this can be an important consequence of task work, and can be described in cognitive/functional terms as a process of usage-based learning, in which constructional schemas guiding L2 production are gradually analysed and elaborated (see Brooks & Tomasello, 1999; Ellis, 2002, 2003; Goldberg, 1995; Goldberg, Casenhiser, & Sethuraman, 2003; Robinson, 1986, 1990; Tomasello, 2000), the Cognition Hypothesis of task-based learning and development also places a heavy responsibility for learning on interaction, and the opportunities interaction affords for the attentional mechanisms of shared attention and noticing to operate which guide usage-based learning and interlanguage development. This thinking is based in part on claims by Schmidt (1983) that mental effort causes destabilization of interlanguage forms, and that attention, and "noticing" is necessary to L2 learning; by Logan (1988) that attention to instances leads to automatization and access in retrieval; and Long (1989) and Swain (1995), that high cognitive/communicative demands cause learners to "push" production, and "stretch" interlanguage (see Robinson, 2000, 2001a, 2001b). In this view, the greater depth of processing (Craik & Lockhart, 1972) induced by complex task demands leads initially to more elaborative processing of input, and noticing of problematic forms in output, and subsequently to greater incorporation, and longer term retention, of forms in the input, and modification of problematic forms in the output (Robinson, 1995b, 2001a; Schmidt, 1990, 1995, 2001), relative to simple task performance (see Figure 5). Study 3, described below, provides some support for these predictions.

Task demands	**Cognitive resources**	**Learning mechanisms**	**Performance effects**
more cognitively —> demanding tasks	more attention—> to input /output and noticing/ rehearsal in memory	more rule and —> instance learning/ stage shifts/ proceduralization/ cue strengthening	more incorporation of input more modification of output, i.e., more uptake of salient input, more stretching and syntacticization of interlanguage

Figure 5. Task complexity and language learning along resource-directing (not resource-dispersing) dimensions (from Robinson, 2001a)

Simple tasks **Complex tasks**
few ID/task interactions **many ID/task interactions**

Production,
<————————— accuracy, complexity, fluency, interaction ——————————>

Learning,
<—————— uptake, modification of output, syntacticization, stage shifts ——————>

Figure 6. Task complexity, individual differences, and production/learning interactions

3.3 Individual Differences Affect Complex Task Performance

Finally, the Cognition Hypothesis also allows a much greater role for individual differences in task-based learning than do proponents of other approaches to task-based instruction and learning theory (see e.g., Nunan, 1989; Skehan, 1998), who have so far been largely concerned with the effects of design features of *tasks*, or *task conditions*, alone on L2 performance. I argue that successful learning and performance is a result of the *interaction* of different aspects of task demands (e.g., *complexity* level and task *conditions*) with learners' patterns of abilities contributing to perceptions of task *difficulty* (Robinson, 2001c, 2002b). There is thus a need to study the nature of the interactions between the triad of factors illustrated in Figure 1 during L2 learning and performance, and in section 4.5 of this paper I make some suggestions about the possible effects of some of these.

The Cognition Hypothesis also specifies the *direction* in which task complexity and individual differences will, in broad terms, interact to cause their effects on learning and performance. That is, in general terms, the Cognition Hypothesis predicts that individual differences play a greater role in complex task performance (on both resource-directing and resource-dispersing dimensions) than they do on simple task performance. While I disagree that individual differences *don't* affect implicit or incidental "acquisition", as some have claimed (e.g., Krashen, 1982; Reber, 1989; Reber & Allen, 2000; and see Robinson, 1997a, 2002a for counterevidence to those claims), I do argue that they *increasingly differentiate performance* on tasks making greater demands on conscious problem-solving procedures during explicit information processing, which make greater demands on task analysis strategies, and on meta-strategies for selecting performance components (Gopher, 1992, 1993; Niwa, 2000; Reder & Schunn, 1999; Robinson, 2001c, 2002a, 2002b, in preparation a; Snow, Kyllonen, & Marshalek, 1984; Sternberg, 1985, 1990, 2002; Wickens, 1984). Study 4 described below, provides evidence in line with this prediction.

4. EVIDENCE FOR THE THREE PROPOSED EFFECTS OF TASK COMPLEXITY

In this section I briefly review evidence from four recent studies in the framework described above that provide some findings in line with the three broad predictions of the Cognition Hypothesis, as well as some that are not, i.e., that (a) task complexity leads to less fluency, greater accuracy and complexity of production, and greater amounts of interaction; (b) task complexity leads to greater amounts of noticing and incorporation of input in learners' production, and thereby likely to more long-term learning; and (c) that individual differences in relevant clusters of cognitive abilities increasingly differentiate performance as tasks increase in complexity. In contrast (though complementary) to the work of other researchers in this area (e.g., Bygate, 1996; Skehan, 1998; Skehan & Foster, 2001) the research described below focuses on the effects of increasing task complexity along the three resource-directing dimensions described in Figure 1, sometimes comparing the effects of tasks differing on one dimension alone, and sometimes (as is the case in real-world task performance) comparing tasks made complex on a number of dimensions simultaneously with performance on their simpler counterparts. Results have been analyzed by performing repeated measure MANOVAs for the multiple measures of production on tasks at different levels of complexity, which in all cases have shown the factor, Task Complexity to be significant at the $p < .05$ level, followed by further planned comparisons of individual measures of production on simple and complex task versions (see e.g., Tables 1 and 2). In some studies, Pearson correlations of measures of individual differences and production on tasks have also been examined, and the significance level of r reported (see e.g., Table 5).

4.1 Study 1. Task Complexity and Monologic Production Along the Here-and-Now, There-and-Then Dimension

To operationalize the Here-and-Now, There-and-Then dimension of complexity, Robinson (1995a) studied high beginner to intermediate level L2 learners of English from a variety of L1 backgrounds (Tagalog, Japanese, Korean and Mandarin) performing narratives in the present tense, while they could view a series of wordless cartoon pictures which described a humorous story (the Here-and-Now) versus performing the narratives from memory, after having viewed the picture prompts, in the past tense (the There-and-Then). In terms of the task condition, *participation* factors described in Figure 1, this was a monologic, and so one-way, open task (since there was no necessarily correct way to tell the story). To establish tense, each participant was asked to begin by reading a short prompt describing the setting of the story (written in the present for the Here-and-Now, and the past for the There-and-Then) before continuing the narrative in their own words. Sequence, picture strip, and condition were counterbalanced in a Latin squares, repeated-measure design, in which each participant performed narratives in both conditions. In line with the claims of Givon (1985; cf. Sato, 1990), that as in early child language, so in second language use in communicatively and cognitively undemanding contexts, where a shared context is available to reduce demands on language form in conveying message content, speakers will make use of a “pragmatic” mode of communication — characterized by lack of grammatical morphology, and parataxis, in contrast to complex syntax and subordination — it was predicted that the more complex There-and-Then condition would elicit more accurate, and complex language, which would also be less fluent. Complexity was measured in multipropositional utterances, (see Sato, 1990), and S-nodes per T-unit, and using a measure of lexical density, percentage of lexical words per utterance; fluency in pauses per utterances, and words per utterance; and accuracy in target-like use (TLU) of a task relevant feature of production, for which there were likely to be many obligatory contexts of use, i.e., the use of articles to refer to and distinguish the characters and other elements in the narratives. Articles are also one of the closed-class features of language that Talmy (2000), as described above, has argued structure the concepts that languages differentially encode. Results showed a strong trend towards greater *accuracy* (p = .06) of TLU of articles on more complex tasks (see Table 1).

Table 1

Descriptive Statistics for Speaker Production on Here and Now (Simple) Versus There and Then (Complex) Narratives (Robinson, 1995a)

	Narrative production					
	MPU	SPT	PPU	WPP	%LW	%TLU
	M/SD	M/SD	M/SD	M/SD	M/SD	M/SD
Here and Now	2.5/1.6	1.5/3.7	15.7/6.1	5.5/2.7	47.7/5.9	62.5/30.3

There and Then	2.2/1.3	1.5/6.1	17.2/10.1	4.2/1.6	52.3/7.4	78.4/24.2
Probability	ns	ns	ns	p =.09	p <.05	p =.06

Key: MPU = Multipropositional utterances; SPT = S nodes per T-unit; PPU = Pauses per utterance; WPP = Words per pause; %LW = percentage of lexical words per utterance; %TLU = percentage of target-like use of articles

This trend to greater accuracy was significant ($p < .05$), using the same materials, but a using a general measure of accuracy (percentage of error free T-units) in a replication by Rahimpour (1997), with Japanese L1 participants. Related to these findings, a similar result was obtained in a much larger scale study by Iwashita, MacNamara, and Elder (2001), who, using different materials, and participants from a wide range of L1 backgrounds, also found that a condition where no context support was provided to enable participants to perform a task resulted in significantly more accurate production (again in percentage of error free T-units) than a condition where participants could view materials as they performed the task. Also in line with the predictions made in Figure 4 above, Robinson (1995a) found significantly greater *lexical complexity/density* (percentages of lexical words per utterance) on the more complex task ($p < .05$). There was a trend to more fluency on the simple task (in words per utterance, but not pauses per utterance), but differences in complexity (multipropositional utterances, and S-nodes per T-unit) were non-significant. Similarly, neither Rahimpour nor Iwashita *et al*. found significant effects for differences in syntactic complexity of production under the two conditions operationalized in their studies.

4.2 Study 2. Task Complexity and Interactive Production Along the -/+ Reference to Many Elements and -/+ Prior Knowledge Dimensions

To examine the effects of tasks made complex on two dimensions simultaneously, Robinson (2001b), operationalized task complexity as version 3 and version 5 of the map task described in Figure 3. In the simpler condition, a small map of an area known to the Japanese L1 participants (their own college campus) was used. In the complex condition, an authentic street map of a much larger area likely to be unknown to the participants (the downtown area of Nihombashi in central Tokyo) was used. One participant was instructed to give directions from point A to point B, both of which were marked on their maps, to a partner who had only point A marked on their map. This was therefore a one-way (since the information-giver was instructing the partner on how to get to point B) closed (since there was a definite correct solution) interactive task (since the partner was able to ask questions about the directions they were given). As in Robinson (1995a) reported above, this was again a repeated measure design, in which half the participants performed the task in the sequence simple-complex, and half in the reverse sequence.

The results showed task complexity significantly ($p < .05$) affected the *lexical variety* (lower token type ratios, and hence more lexical complexity on the complex version) and f*luency* (more words per clausal, or C-unit on the simple version) of speaker production (see Table 2). The study also showed significantly greater *interaction*, measured in hearer comprehension checks ($p < .05$) on the complex version, and also a trend to more clarification requests in the same direction. However, syntactic complexity measured in clauses per C-unit, and accuracy, measured in percentage error free C-units, were not significantly affected by complexity (though cf. a study by Newton & Kennedy, 1996 who *did* find significantly greater complexity of production on a complex version of a similar interactive task).

In this study, and in the following studies to be reported, we have also examined the effects of increasing task complexity on learner perceptions of task “difficulty”, using a procedure whereby learners complete Likert scale responses (on a scale from 1 to 9) to five questions immediately following task performance. These questions assess learners’ overall perceptions of task *difficulty*, (this task was easy/this task was hard) the extent to which they found the task *stressful* (I felt relaxed doing this task/I felt frustrated doing this task), their *confidence* in their ability to successfully complete the task (I did the task well/I did not do this task well), and the *interest* in (this task was not interesting/ this task was interesting), and *motivation* to complete similar tasks (I don't want to do more tasks like this/ I want to do more tasks like this). The results have been extremely consistent: as in the study reported here (Robinson, 2001b) (see Table 3) in each case increases in task complexity manipulated along the dimensions described in Figure 1 have been accompanied by significantly higher learner ratings of task difficulty, and stress, but non significant differences in task interest, or task motivation. In many cases, learners have also rated their ability to perform the task significantly higher on less complex versions relative to complex versions. These findings show, then, that the dimensions of *complexity* manipulated during task design in this framework also correspond well with learners' perceptions of the *difficulty* of the task, and so therefore indicate that learners are to a large extent "construing" tasks demands in a way consistent with the task designer's intentions (see Schwartz, 1996; Stanovitch & West, 2000, for extensive treatment of the issue of task construal, i.e., that subjects might frame a problem or task in a different way than that intended by the task designer or researcher, and Coughlan & Duff, 1993, for mention of this issue in the context of task-based L2 research). We have also examined the correlations of scores on these questionnaire responses with measures of learner production, finding some suggestive significant correlations ($p < .05$), e.g., in the study reported here between fluency, measured quantitatively in words per C-unit, and perceptions of ability to complete the task, on both simple and complex versions. These findings have also suggested that while perceptions of difficulty are related to some aspects of language performance, most notably fluency, they are in general a less robust influence on production than the design features of the task itself, contributing to differences in complexity.

Table 2

Descriptive Statistics for Speaker Production and Hearer Interaction on Simple and Complex Versions of a Map Task (Robinson, 2001b)

	Speaker production				Hearer production	
	TTR M/SD	%EFC M/SD	WPC M/SD	CPC M/SD	CC M/SD	CR M/SD
Simple	4.3/1.4	58/17	6.6/1.4	1.05/0.8	1.9/2.3	0.8/1.0
Complex	3.6/1.1	62/13	5.9/1.3	1.05/0.8	4.5/3.5	1.5/1.4
Probability	$p = .01$	$p = .13$	$p = .03$	ns	$p < .01$	ns

Key: TTR = Token type ratio; %EFC = percentage of error free C-units; WPC = Words per C-unit; CPC = Clauses per C-unit; CC = Confirmation checks; CR = Clarification requests

Table 3

Descriptive Statistics for Responses to the Map Task Difficulty Questionnaire (Robinson, 2001b)

	Difficulty M/SD	Stress M/SD	Ability M/SD	Interest M/SD	Motivation M/SD
Simple	3.5/2.1	3.7/2.3	5.0/2.1	5.0/2.1	5.3/2.1
Complex	5.4/2.3	4.8/2.4	4.4/2.0	5.7/2.1	5.2/2.3
Probability	$p <.01$	$p <.01$	$p =.07$	$p =.08$	ns

Key: TTR = Token type ratio; %EFC = percentage of error free C-units; WPC = Words per C-unit; CPC = Clauses per C-unit; CC = Confirmation checks; CR = Clarification requests

4.3 Study 3. Task Complexity, Interaction and Incorporation of Modified Input Along the –/+ Reasoning Demands Dimension

Two studies (again using university aged, Japanese L1 learners of English, as in study 2) have operationalized the –/+ reasoning demands dimension of complexity, using the same materials. In the first of these (Robinson, 2000), in a one-way, interactive, closed dyadic task, one participant was asked to view a randomly ordered series of pictures showing characters performing different actions, and decide which chronological sequence they should be arranged into in order to depict a coherent story, and also to tell a partner (who could ask questions) the story that the series of pictures described (i.e., in the chronological order they had chosen). The partner was instructed to sequence their own randomly ordered series of pictures in the order that corresponded to their partner's story. Reasoning demands were differentiated by using the least (set 1), and most complex (set 9) picture sequences from the picture arrangement (PA) subtest of the Wechsler Adult Intelligence Scale, Revised version (WAIS-R), and one sequence of pictures (set 5) that was intermediate between the least and most complex. In the PA subtest, sets of pictures progressively increase in the demands they make on the ability to reason about characters motives for, and intentions in, performing actions. The most simple sequence consists of three pictures depicting three stages, or successive actions, in the construction of a house. It does not require reasoning about the motives, intentions or other thoughts of people. However, in the most complex version, pictures can only be successfully sequenced if such motives, intentions and thoughts can accurately be inferred. There is only one correct sequence in each case, making it a closed task.

In terms of elements of complexity in Figure 3, this task was — single task (i.e., speakers had to both think of the sequence *and* tell the story, making it a dual task), + prior knowledge (the events described in each narrative were within the range of all participants' prior experience), — planning time, and — many different elements. Only reasoning demands were gradually increased on each version of the tasks making reasoning demands the only factor differentiating task complexity. Following from the Cognition Hypothesis the hypotheses were that not only would there be more *interaction, and negotiation* on the more complex task (as found in the second study reported above) but also that learners would look for more and more help in the input as task demands increased in complexity, and therefore that there would be more *incorporation* of input available to aid learners in performing the task.

Input was operationalized as language that would be "helpful" in, though not necessarily essential to, performing the story-telling task (cf. Loschky & Bley-Vroman, 1993; Samuda, 2001) and was provided in written form on the speaker/information giver's picture prompts. This task-relevant input consisted of six phrases in English, with Japanese translations, written below each of the three series of picture strips. The six phrases on each narrative were controlled for equivalent grammatical structure: i.e., three phrases each of the types (a) verb—present continuous, object, and (b) subject, verb—3rd person-s morpheme, adverb. The lexical content of the phrases was varied to make them relevant to the content of each particular narrative. So for example, for the least complex picture sequence, which described a man building a house, two phrases in the input were *is carrying a plank* and *he saws quickly*, while for the most complex narrative, which described a man taking a taxi ride, two phrases were *is hailing a taxi* and *he walks tiredly*.

Incorporation of input was measured in two-ways. *Partial* uptake and incorporation was coded as the use of one or more of the content words in any given phrase (not counting grammatical words, such as articles, auxiliary verbs, or pronouns), and *exact* uptake and incorporation was coded as the use of the whole, unaltered, phrase during task performance. Turns were coded in two-ways. Turns with *aizuchi* counted interlocutor responses, such as *yes*, *right*, *I see*, that functioned simply as feedback that the listener was attending, as separate turns. Turns without *aizuchi* did not include such responses as separate turns. Results are shown in Figures 7, 8 and 9.

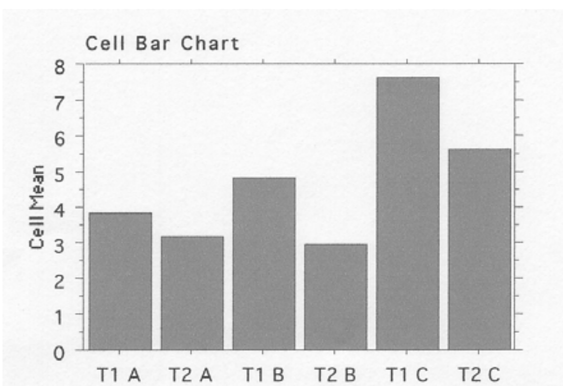

Figure 7. Interaction, turntaking, and reasoning complexity for the information-giver, speaker on an interactive narrative task.
Key: T1= turns including aizuchi; T2=turns excluding aizuchi; a=easy, b=mid, c=complex reasoning.

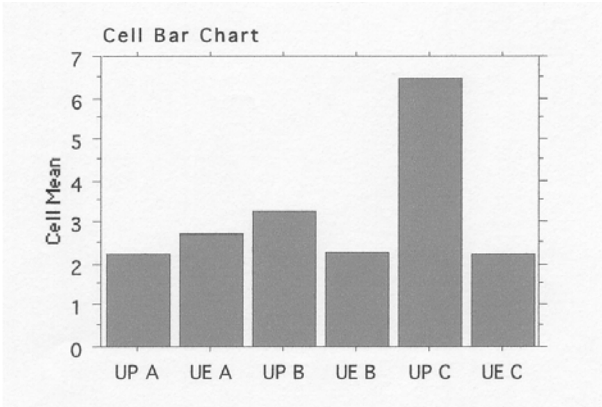

Figure 8. Uptake, incorporation, and task complexity for the information-giver, speaker on an interactive narrative task.
Key: UP=uptake partial; UE=uptake exact; a=easy, b=mid, c=complex reasoning.

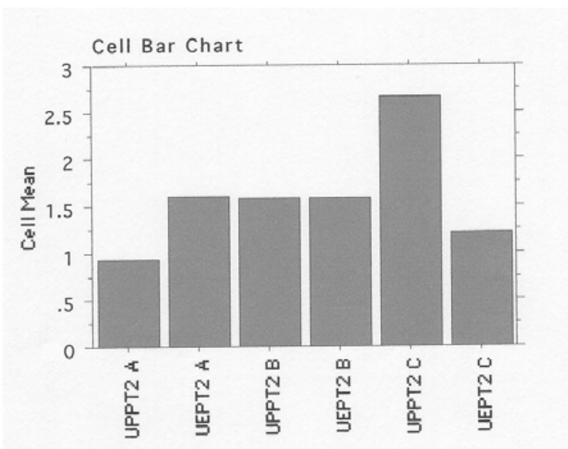

Figure 9. Uptake partial and exact per turn and task complexity for the information-giver, speaker on an interactive narrative task.
Key: UPPT=uptake partial per turn; UEPT=uptake exact per turn; a=easy, b=mid, c=complex reasoning.

Figure 7 shows turntaking (both with and without aizuchi) for the twenty one dyads in the study increased over progressively complex tasks. Repeated-measures ANOVAs show this difference to be significant for turns both with ($F = 6.401$, $p = .003$) and without aizuchi ($F = 4.919$, $p = .01$). Figures 8 and 9 show that uptake and incorporation input also progressively increased over more complex tasks, both in terms of total numbers of occurrences (Figure 8) and in terms of a ratio measure of amount of incorporation per turn (Figure 9). A repeated measure ANOVA of uptake per turn for the three tasks shows this to be significant only for partial uptake and incorporation of input per turn ($F = 5.214$, $p = .009$), but not for exact uptake and incorporation per turn, which remained at a constant level over the tasks (see Table 4). Nonetheless, more partial incorporation of input provides some support for one of the claims about the effects of task complexity on learning made in the Cognition Hypothesis I have described. The greater the cognitive demands of the task, the more learners will attend to, and use, input to the task (which could be made salient in any of a variety of ways), and so incorporate and practice aspects of the L2 (e.g., present progressive -ing morphemes, 3rd person-s morphemes, and word order for adverb placement, in this study) over which they may have low control, or grammatical and lexical forms and structures they may not yet have acquired.

Table 4

Descriptive Statistics for Information-Giver, Speaker Turntaking, and Uptake and Incorporation, on Tasks at Different Levels of Reasoning Complexity (Robinson, 2000)

	Reasoning Task Complexity		
	Low	Mid	High
	M/SD	M/SD	M/SD
Number of turns			
(with aizuchi, T1)	3.85/3.0	4.8/4.0	7.6/5.7
(without aizuchi, T2)	3.2/2.4	2.9/2.1	5.6/4.7
Uptake and incorporation			
Uptake partial	2.2/2.4	3.2/2.2	6.5/3.6
Uptake extact	2.7/1.8	2.2/2.1	2.2/2.2
Uptake partial per turn	0.94/0.81	1.57/1.0	2.7/3.0
Uptake exact per turn	1.6/1.8	1.57/1.8	1.2/1.6

This study, then, addressed only the claim that more complex tasks would lead to more attention to, and incorporation of task relevant input. Stronger evidence for the claims of the Cognition Hypothesis would involve documenting actual pre/post-task performance gain in a domain targeted by the input, both in the short, and longer term, as well as manipulating the attentional salience of input in ways other than the off-line approach adopted here. That is, the same effects may be found for greater uptake and incorporation of task input made available on-line during complex task performance using such techniques as recasts of learner utterances, as learners attempt to achieve greater syntacticization and grammaticization of their current interlanguage in order to meet the complex cognitive and functional and demands of the task. If so, this would suggest that learner interlanguages are more permeable and susceptible to modification during complex task performance, than during simple task performance, which draws on a relatively stable, easily accessible, but simpler, pragmatic variety of the L2. In this way, shifts from what Givon (1985, 1995) has called the pragmatic to the syntactic variety of interlanguage may take place across simple to complex task sequences. These are issues for future research.

4.4 Study 4. Task Complexity, Monologic Production and Individual Differences Along the -/+ Reasoning Demands Dimension

Niwa (2000) also studied the effects of task complexity on language production along the -/+ reasoning demands dimension of complexity. She operationalized + dual task, and the -/+ reasoning demands dimensions of task complexity using four picture strips from the Wechsler Adult Intelligence Scale-Revised PA subtest, as in study 3, described above. As in the study reported above, Japanese L1 participants ($N = 22$) were asked to decide on the sequence, *and* also tell the story (all stories were thus dual tasks) in English. In contrast to the study reported above, however, this was not an interactive task, since participants were instructed only to tell the story described by the picture sets: there was no interlocutor participation. In this study the four stories again included the least complex and the most complex (sets 1 and 9), and two intermediate levels of complexity from the PA test (sets 3 and 7). Thus, they varied from simple to complex in reasoning demands. Looking at the effects of individual differences in intelligence (using a short form of the WAIS-R), aptitude (the Language Aptitude Battery for the Japanese, LABJ, Sasaki, 1996), and working memory (Osaka & Osaka's 1992 reading span test) on accuracy, fluency and complexity, Niwa found the pattern of correlations described in Table 5, with measures of speaker production on the four narratives.

These correlations suggests that as tasks increase in their *complexity*, so *individual differences* in cognitive abilities (intelligence, aptitude and working memory) *increasingly differentiate performance*, especially in the area of fluency. As Table 2 shows, there are more significant correlations of individual differences with performance on the most complex task (five) than on any other task. Higher aptitude is associated with less time on narrative for all tasks, and for the most complex task, higher working memory and aptitude are associated with less fluency, i.e., more pausing (fewer words between pauses, and fewer seconds between pauses), as learners try to meet the demands of telling the story illustrated by the most complex set of pictures. This is possibly because those learners with greater working memory and aptitude are making greater efforts to be accurate and produce complex syntax on complex tasks (as the Cognition Hypothesis predicts) than those with lower abilities. This, then, suggests that the effects the Cognition Hypothesis predicts (and perhaps any predictions for the effects of task design features on second language learner performance) may be found more clearly in populations of learners strong in complexes of abilities drawn on by a particular task, than for other populations of learners (see Robinson, 2001c). An important question then, is whether such individual differences will emerge to differentiate learning and uptake of focus on form on more complex tasks, as Niwa shows they do for production.

Table 5

Correlations of aptitude, intelligence and working memory with narrative production at four levels of reasoning complexity (Niwa, 2000)

	Narrative production							
	Accuracy	Fluency					Complexity	
	EFT	TIME	WPS	SBP	WPP	WPT	SPT	TTR
Reasoning complexity								
Narrative 1 (simple)	ns	Apt* -.48	ns	ns	ns	ns	ns	ns
Narrative 2	ns	Apt* -.5	ns	ns	ns	Apt** -.59	ns	Apt** .61
Narrative 3	ns	Apt* -.42	ns	ns	ns	ns	ns	ns
Narrative 4 (complex)	Int* -.45	Apt* -.44	ns	Apt/* WM** -.45/ -.55	WM* -.47	ns	ns	ns

Key: * = $p < .05$; ** = $p < .01$; ns = $p > .05$; EFT = percentage of error free T-units; TIME = time on narrative; WPS = words per second ; SBP = seconds between pauses; WPP = words per pause; WPT = words per T-unit; SPT = S nodes per T-unit; TTR = type token ratio.

In summary, the review of recent findings shows some support for claims 2 and 3 of the Cognition hypothesis, that increasing task complexity leads to more uptake and incorporation of input (Robinson, 2000), and so, possibly, more long-term learning from the input, and that individual differences increasingly affect complex task performance (Niwa, 2000). It shows support too for claim 1, about the effects of task complexity on production. There is evidence that task complexity leads to significantly greater amounts of interaction (measured in turntaking), and negotiation work (measured in comprehension checks and clarification requests) (Robinson, 2000, 2001b) and such interaction and negotiation work may, as Long (1996, p. 453) notes, "make detection both of new forms and of mismatches between input and output more likely". There is also evidence for less fluency on complex tasks (Robinson, 2001b), and on the Here-and-Now/There-and-Then dimension there is support for the proposed beneficial effects of task complexity on accuracy, using a specific measure (TLU of articles, Robinson, 1995a) and more general measures of accuracy (Iwashita *et al*. 2001; Rahimpour, 1997, 1999). In contrast, there is to date little support for the proposed effects of task complexity in progressively pushing learners to attempt more complex syntax. However, as study 4 shows, individual differences in cognitive abilities also mediate task performance, and language production (Niwa, 2000), and clearer findings supporting (or disconfirming) the Cognition Hypothesis predictions for accuracy and complexity may well only emerge clearly if individual differences are properly controlled for.

4.5 Other Issues for Future Research

The summary of findings in the componential framework described in Figure 1 has focussed on the effects of task complexity along the three resource-directing dimensions described earlier in this paper. However, studying the effects of increasing task complexity along these dimensions, and its effects on speech production, interaction, and uptake of task relevant input, will also need to account for the possible *interactions* of task complexity with the other task *condition* (participation and participant), and task d*ifficulty* (cognitive and affective) factors described in Figure 1 in causing these effects.

For example, with regard to *participation* factors illustrated in Figure 1, the proposal that complex tasks along resource-directing dimensions will push learners to greater complexity of speech may be clearer when those tasks are one-way, compared to two-way tasks, since the greater amount of interaction and turntaking facilitated under the latter task condition (see Doughty & Pica, 1986; Pica, 1987) may mitigate against the attempt of either participant to produce extended utterances and lengthy turns. Similarly, when tasks are closed, requiring a single correct answer, as opposed to open, where a variety of answers are possible (see Long, 1989), the proposed effects of task complexity on complex speech may also be stronger, since open tasks potentially allow learners to avoid using complex syntax they may not have confidence in producing. That is, open tasks may lead learners to meet task demands in ways that can be articulated using their favored and established repertoire of routines and expressions, rather than pushing them to extend these. Mapping such interactions will be important. The summary of research above also suggests a number of other areas where further research is particularly necessary, and I briefly address three of these below.

4.5.1. How does task complexity affect changes in production, using theoretically motivated measures of fluency, complexity, and accuracy? The Cognition Hypothesis claims that more complex tasks will push development, and greater complexity and accuracy of production. The studies I have cited examine this claim using general descriptive measures, such as clauses, and S-nodes per T or C-unit, or percentage error free C-units. There is some merit in these descriptive units of analysis, since they have previously been widely adopted in other task research, for example into the effects of planning time (see Skehan, 1998), enabling broad comparisons of results across studies to be made. But future studies also need to look at accuracy and complexity using interlanguage-sensitive measures of developmental change (see e.g., Bardovi-Harlig, 2000; Li & Shirai, 2000; Meisel, 1987; Perdue, 1993a, 1993b; Sato, 1990), not just target-like use, or clausally defined measures of complexity. This is particularly so since I have argued that different resource-directing dimensions of complexity can prompt attempts at increased syntactic complexity, and grammaticization, in different domains of the L2 — for example, the domain of temporal reference in the case of the Here-and Now/There-and-Then dimension, versus use of subordinating conjunctions, and use of cognitive state verbs, e.g., “believe”, “know”, and the complementation that accompanies them in the case of -/+ reasoning demands. Additionally, studies could also base complexity metrics on predictions of general theories of language processing and performance (see e.g., Hawkins, 1994; Wasow, 2002), and on models of L2 processing and development, such as those of Pienemann (1998), in addition to the functionalist frameworks of Givon, Talmy, and Klein and Perdue I have cited.

4.5.2 How does task complexity affect noticing and learning during interaction? The Cognition Hypothesis claims that more learning and retention will take place as a consequence of complex task performance. To examine this, studies need to look at effects of task complexity on uptake of information made salient by recasting, flooding, textual input enhancement, proactive rule description, and other techniques for Focus on Form described by Doughty and Williams (1998), using measures sensitive to retention of more implicit, as well as more explicit FonF techniques; that is, using both explicit/direct, and implicit/ indirect measures of memory (see Merickle & Reingold, 1991; Robinson 1995b, 1996b, 2003a). If this claim is found to be supported it will have important implications for Focus on Form studies that attempt to assess the relative effectiveness of one technique, versus another, since it will suggest that task complexity should be operationalised as an important moderator variable that needs to be controlled for if the true extent of the relative effectiveness of various Focus on Form techniques is to be clearly established.

4.5.3 How do individual differences interact with task complexity to affect learning and L2 development? The issue of linking individual differences in abilities to task requirements is both theoretically, and pedagogically important (see Ackerman & Cancielo, 2002; Ackerman, Kyllonen, & Roberts, 1999; Fleishman & Quaintance, 1984; Snow, 1994). Thus, studies need to examine how individual differences in ability variables (e.g., aptitude, working memory) and affective factors (motivation and anxiety) interact with production and learning on tasks at different levels of complexity (see e.g., Niwa, 2000; Robinson, 2002b, in preparation a; Shimizu, 2003). The Cognition Hypothesis further claims that individual differences in the cognitive and affective factors contributing to perceptions of task “difficulty” will increasingly differentiate performance and learning as tasks increase in their complexity. This general claim is in line with much of the work of Snow and his colleagues on the relationship between abilities and academic tasks in a variety of domains (Corno et al., 2002; Snow, Kyllonen, & Marshalek, 1984).

However, it is also possible to chart the interaction of strengths and weaknesses in the cognitive abilities contributing to aptitudes, or "aptitude complexes" for L2 learning (see Robinson, 2001c, 2002a, 2003b), with *specific* design features of L2 tasks I have described, which can be manipulated to increase task complexity. With the framework described in Figure 1 for L2 cognitive task analysis in mind, it is likely, for example, that research into individual differences in the ability to "switch" attention between task components described by Segalowitz (2001, 2002; see also Rubinstein, Meyer, & Evans, 2001) could be an important component of the aptitude complex for learning and performance on L2 tasks which increase in complexity on the single to dual task dimension, where this dimension is operationalized as tasks requiring only one component step (e.g., describing a route already marked on a map) to tasks requiring two simultaneous steps (thinking up the route, while also describing it — see Robinson, 2001a, summarised above, for such a study). Similarly, a number of measures of reasoning ability exist (see e.g., Schaeken, De Vooght, Vandierendonck, & Y'deWalle, 2002; Stanovitch, 1999) which could be adapted to assess aptitudes for performance and learning on the -/+ reasoning demands dimension of complexity (as in studies three and four summarised above). It may also be that some individual differences (e.g., in working memory) are especially influential on task performance on *one* of the dimensions I have mentioned (e.g., the Here-and-Now versus There-and-Then) but relatively less so on others (e.g., the extent of reasoning demands). These specific interactions will also need to be charted and explored, especially if learners are to be *matched* to tasks and dimensions of complexity that complement their patterns of cognitive abilities, or alternatively, *supported* in their attempts to perform tasks along dimensions which may be particularly difficult, given a learner's deficit in the abilities they draw on (see Robinson, 2001c, in preparation a). Such work would both illuminate the extent to which learner perceptions of the difficulty of the task inhibit, or accentuate task-based language processing and also provide a basis for *matching* learners' patterns of abilities to those particular types of task which facilitate their processing and learning—thereby optimising periods of exposure and task-based language practice.

5. SUMMARY OF THE MAIN CLAIMS OF THE COGNITION HYPOTHESIS

The Cognition Hypothesis of task-based L2 development put forward here (cf. Robinson, 2001a, 2001b) can be seen as a variant of Cromer's (1974) cognition hypothesis of L1 development, with the difference that for adult L2 development, it is not (as in childhood) cognitive maturation that creates the vacuum that language fills as a means of expression, but the demands of the task, which by increasing in complexity along some resource-directing dimensions I have described, can recapitulate the course of conceptual change over time in childhood (e.g., by requiring reference first to the Here-and-Now, then to the There-and-Then). Note, Cromer (1988) came to reject the strong form of the cognition hypothesis for L1 development, accepting innate mechanisms of L1 development that functioned to independently of cognitive maturation. For adults, however, if access to such innate linguistic knowledge is attenuated, or just not possible, and if an explanation for some of the parallels between child and adult language development apparent from the work of the ESF project is, as Slobin suggests, to be found elsewhere, i.e., that “adult learners retain a scale of conceptual complexity, based on their own cognitive development, and at first search the TL (target language) for the grammatical marking of those notions” (1993, p. 243), then there is a much stronger argument for a form of this hypothesis as a motivation for sequencing decisions which aim to promote task-based L2 language development.

Much research remains to be done to test the claims of the Cognition Hypothesis I have described, across a variety of L2 domains, but early results suggest it may be on the right lines in predicting the effects of task complexity on some aspects of L2 production, such as fluency and (though to a lesser extent) accuracy; the amount of turntaking and interaction a task encourages; the amount of uptake and incorporation of forms made salient in the input on tasks at different levels of complexity; and the role of individual differences in differentiating these effects. What is also important is the “feasibility” of the basic framework I have described, as a source of criteria for decision making about design features of tasks, and task classification, pedagogic sequencing, and testing decisions based on them (Iwashita, Elder, & MacNamara, 2001; Long & Crookes, 1992, 1993; Robinson, Nobe, Strong,, & Whittle, 2001; Robinson & Ross, 1996). Recent work in language testing (e.g., Iwashita *et al*., 2001; Wigglesworth, 2001) has adopted a number of the dimensions of task complexity I have described for the purpose of examining the comparability of forms of tests, and this componential framework has also been used outside research contexts, for example, to design, classify, grade and sequence second language tasks in EAP university level settings (e.g., D.Ellis, 2000; Lee, 2000; Sheppard, 2000), and in the design of computerised instructional materials (Appel & Gilabert, 2002).

The marriage of feasibility or practical utility, and theoretical and empirical SLA support for criteria for sequencing units of L2 classroom activity is the goal of many (not only task-based) approaches to L2 syllabus design. As has been argued elsewhere, however (Long, 1998; Long & Crookes, 1992; Long & Robinson, 1998; Robinson, 1998; Robinson & White, 1995), choice of *linguistic* units as the basis of syllabus sequencing decisions often assumes that what is taught is what is learned (the structure of the day, week, or month), and that learning is a linear, additive process, which takes place in lockstep, for all learners in a group, over a course of instruction. There is evidence against these assumptions, showing developmental sequences across languages that do not fit well with traditional structural grading criteria, particularly since such sequences, for example, in the acquisition of negation, or tense and aspectual distinctions, often involve lengthy periods of producing non-target-like forms (e.g., Dulay & Burt, 1974; Klein, 1989; Larsen-Freeman & Long, 1991; Li & Shirai, 2000; Perdue, 1993b; Pienemann, 1998). Research has also shown the non-linearity of learning processes in many domains of L2 development, such as sudden shifts in developmental stages, backsliding, the sudden generalizability of instruction on some more marked, versus unmarked forms, and so called U-shaped learning curves (see Eckman, Bell, & Nelson, 1988; Kellerman, 1985; Klein, 1989); as well as differential rates of progress by learners with different patterns of cognitive abilities contributing to aptitude for L2 learning and production (Robinson, 2002d; Skehan, 1989, for discussion).

An alternative motivation for sequencing the units of classroom activity that I have sought to explore in this paper, in line with a number of current and previous proposals (e.g., Candlin, 1987; Long, 1985, 1998: Long & Crookes, 1992; Skehan, 1998) is to take second language *tasks* as the units of syllabus design, and to base decisions about sequencing them in large part on differences in their cognitive complexity. This approach to syllabus design, I would argue, is in many ways no different from that adopted in other areas of training and instruction, in which, for example, simpler math problems, or pilot-training simulations, are practiced before more complex versions. More importantly, if one assumes that in second language education we are developing learners' ability to accomplish real-world activities through the L2, and that by engaging in increasingly complex cognitive and communicative tasks, language will adapt and develop under functional pressure to meet the demands of those tasks (or if not can be pressured to through pedagogic interventions which focus on form), then the approach I have described here is not only feasible, but motivated by a view of language *development* (along resource-directing dimensions of complexity) and its successful *deployment* (along resource-dispersing dimensions) that is compatible with the long-held goals of communicative approaches to second language instruction. What I hope to have achieved in this paper is to have brought together these developmental and performance issues implicated in task-based L2 learning in one framework for task design, as well as to have described dimensions for manipulating both, which are pedagogically feasible, and which can therefore be used to guide decision-making about sequencing in task-based approaches to syllabus construction.

REFERENCES

Ackerman, P. L., & Ciancolo, A.T. (2002). Ability and task constraint determinants of complex task performance. *Journal of Experimental Psychology: Applied*, *8*, 194-208.

Ackerman, P., Kyllonen, P., & Roberts, R. (Eds.) (1999). *Learning and individual differences: Process, trait and content determinants*. Washington, DC: American Psychological Association.

Appel, C., & Gilabert, R. (2002). Motivation and task performance in a task-based, web-based tandem project. *ReCALL , 14*(1).

Bardovi-Harlig, K. (2000*). Tense and aspect in second language acquisition: Form, meaning and use*. Oxford: Blackwell.

Bartsch, K., & Wellman, H. (1995). *Children talk about the mind.* Oxford: Oxford University Press.

Baron-Cohen, S. (1995). *Mindblindness: An Essay on autism and theory of mind*. Cambridge, MA: MIT Press.

Bates, E., Dale, P., & Thal, D. (1996). Individual differences and their implications for theories of language development. In P. Fletcher & B. MacWhinney (Eds.), *Handbook of child language acquisition* (pp. 96-151). Oxford: Blackwell.

Becker, A, & Carroll, M (Eds.) (1997). *The acquisition of spatial relations in a second language.* Amsterdam: John Benjamins.

Behrens, H. (2001). Cognitive-conceptual development and the acquisition of grammatical morphemes: the development of time concepts and verb tense. In M. Bowerman & S. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 450-474). Cambridge: Cambridge University Press.

Bellugi, U., Marks, S., Bihrle, A., & Sabo, H. (1988). Dissociation between language and cognitive function in Williams syndrome. In D. Bishop & K. Mogford (Eds.), *Language development in exceptional circumstances* (pp. 177-189). New York: Churchill Livingstone.

Berman, R., & Slobin, D. (1994). *Relating events in narrative: A crosslinguistic developmental study*. Mahwah, NJ: Erlbaum.

Bialystok, E. (1991). Metalinguistic dimensions of bilingual language proficiency. In E. Bialystok (Ed.), *Language processing in bilingual children* (pp. 113-140). London: Cambridge University Press.

Bley-Vroman, R. (1990). The logical problem of foreign language learning. *Linguistic Analysis, 20,* 3-49.

Brinton, D., Snow, M., & Wesche, M. (1989). *Content based second language instruction.* Rowley, MA: Newbury House.

Bronckart, J., & Sinclair, H. (1973). Time, tense and aspect. *Cognition, 2*, 37-45.

Brooks, P., & Tomasello, M. 91999). How children constrain their argument structure constructions. *Language, 75,* 720-738.

Bygate, M. (1996). Effects of task repetition: Appraising the developing language of learners. In J. Willis & D. Willis (Eds.), *Challenge and change in language teaching* (pp. 136-146). Oxford: Heinemann.

Bygate, M. (2001). Effects of task repetition on the structure and control of language. In M. Bygate, P. Skehan, & M. Swain (Eds.), *Researching pedagogic tasks: Second language learning, teaching, and testing* (pp. 23-48). London: Longman.

Candlin, C. (1987). Towards task-based language learning. In C. Candlin & D. Murphy (Eds.), *Language learning tasks* (pp. 5-22). London: Prentice Hall.

Carassa, A., Aprigliano, A., & Geminiani, G. (2000). Describers and explorers: A method for investigating cognitive maps. In S. O'Nuallain (Ed.), *Spatial cognition* (pp. 33-43). Amsterdam: John Benjamins.

Carey, S., & Spelke, E. (1994). Domain specific knowledge and conceptual change. In L. Hirschfeld & S. Gellman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 169-200). New York: Cambridge University Press.

Chapman, R. (1996). Language development in children and adolescents with Down syndrome. In P. Fletcher & B. MacWhinney (Eds.), *Handbook of child language acquisition* (pp. 641-663). Oxford: Blackwell.

Chown, E., Kaplan, S., & Kortenkamp, D. (1995). Prototypes, Location and Associative Networks (PLAN): Towards a unified theory of cognitive mapping. *Cognitive Science, 19,* 1-51.

Cornell, E., Heth, D., & Alberts, D. (1994). Place recognition and way finding by children and adults. *Memory and Cognition, 22*, 633-643.

Corno, L., Cronbach, L. J., Kupermintz, H., Lohman, D. F., Mandinach, E. B., Porteus, A. W., & Talbert, J. E. (2002). *Remaking the concept of aptitude: Extending the legacy of Richard E. Snow*. Mahwah, NJ: Erlbaum.

Coughlan, P., & Duff, P. (1993). Same task, different activities: Analysis of an SLA task from an activity theory perspective. In J. Lantolf & P. Appel (Eds.), *Vygotskian approaches to second language research* (pp. 157-172). Norwood, NJ: Ablex.

Craik, F., & Lockhart, R. (1972). Levels of processing: A framework for memory research. *Journal of Verbal learning and Verbal Behavior, 11*, 671-684.

Crombie, W. (1985). *Discourse and language learning: A relational approach to syllabus design*. Oxford: Oxford University Press.

Cromer, R. (1974). The development of language and cognition: The cognition hypothesis. In B. Foss (Ed.), *New perspectives in child development* (pp. 184-252). Harmondsworth: Penguin.

Cromer, R. (1988). The cognition hypothesis revisited. In F. S.Kessel (Ed.), *The development of language and language researchers: Essays in honor of Roger Brown* (pp. 223-248). Hillsdale, NJ: Erlbaum.

Cromer, R. (1991). *Language and thought in normal and handicapped children*. Oxford: Blackwell.

Crookes, G. (1986). *Task classification: A cross disciplinary review.* Technical Report No. 4: Center for Second Language Classroom Research. Honolulu: University of Hawaii.

DeKeyser, R. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition, 22*, 499-533.

DeKeyser, R., Salaberry, R., Robinson, P., & Harrington, M. (2002). 'What gets processed in Processing Instruction?': A commentary on Bill VanPatten's 'Update'. *Language Learning, 52*, 805-823.

Doughty, C. (2001). Cognitive underpinnings of focus on form. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 204-255). Cambridge: Cambridge University Press.

Doughty, C., & Pica, T. (1986). Information gap tasks: An aid to second language acquisition? *TESOL Quarterly, 20*, 305-325.

Doughty, C., & Williams, J. (1998). Pedagogical choices in focus on form. In C. Doughty & J. Williams (Eds.), *Focus on form in classroom second language acquisition* (pp. 197-262). New York: Cambridge University Press.

Dulay, H., & Burt, M. (1974). Natural sequences in child second language acquisition. *Language Learning, 24*, 37-53.

Eckman, F., Bell, L., & Nelson, D. (1988). On the generalization of relative clause instruction in the acquisition of English as a second language. *Applied Linguistics, 9,* 1-20.

Ehret, B., Gray, W., & Kirschenbaum, S. (2000). Contending with complexity: Developing and using a scaled world in applied cognitive research, *Human Factors, 2*, 8-23.

Elder, C., Iwashita, N., & Macnamara, T. (2002). Estimating the difficulty of oral proficiency tasks: What does the test-taker have to offer? *Language Testing, 19*, 347-368.

Ellis, D. (2000). *Task complexity and task sequencing in an EAP reading program.* Unpublished course materials, English Language Unit, Al Ain University, U.A.E.

Ellis, N. (2002). Frequency effects in language acquisition: A review with implications for theories of implicit and explicit language acquisition. *Studies in Second Language Acquisition, 24*, 143-188.

Ellis, N. (2003). Constructions, chunking, and connectionism: The emergence of second language structure. In C. Doughty & M. Long (Eds*.), The handbook of second language acquisition.* Oxford: Blackwell.

Elman, J., Bates, E., Johnson, M., Karmiloff-Smith, A., Parisi, D. & Plunkett, K. (1996). *Rethinking innateness: A connectionist perspective on development.* Cambridge, MA: MIT Press.

Fleishman, E. A., & Quaintance, M. K. (1984). *Taxonomies of human performance: The description of human tasks*. Orlando, FL: Academic Press.

Givon, T. (1985). Function, structure, and language acquisition. In D. Slobin (Ed*.), The crosslinguistic study of language acquisition: Vol 1*. (pp. 1008-1025). Hillsdale, NJ: Lawrence Erlbaum.

Givon, T. (1995). *Functionalism and grammar.* Amsterdam: Benjamins.

Givon, T. (2002). The visual information-processing system as an evolutionary precursor of human language. In T. Givon & B. Malle (Eds). (2002). *The evolution of language out of pre-language*. (pp. 3-50). Amsterdam: Benjamins.

Goldberg, A. (1995*). A construction grammar approach to argument structure*. Chicago, IL: University of Chicago Press.

Goldberg, A., Casenhiser, D., & Sethuraman, N. (2003). *Learning argument structure generalizations.* Manuscript under submission.

Gopher, D. (1992). Analysis and measurement of mental workload. In G. d'Ydewalle, P. Eelen & P. Bertelson (Eds.), *International perspectives on psychological science: Vol. 2, State of the art* (pp. 265-291). Hillsdale, NJ: Lawrence Erlbaum.

Gopher, D. (1993). The skill of attention control: Acquisition and execution of attention strategies. In D. Meyer & S. Kornblum (Eds.), *Attention and performance XIV: Synergies in experimental psychology, artificial intelligence, and cognitive neuroscience* (pp. 299-322). Cambridge, MA: MIT Press.

Gopnik, A., & Wellman, H. (1994). The theory theory. In L. Hirschfield & S. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture*, (pp. 257-293). New York: Cambridge University Press.

Harley, B. & Hart, D. (2002). Age, aptitude, and second language learning on a bilingual exchange. In P. Robinson (Ed.), *Individual differences and instructed language learning*. Amsterdam: John Benjamins.

Hawkins, J. (1994*). A performance theory of order and constituency.* Cambridge: Cambridge University Press.

Hyltenstam, K., & Abrahamsson, P. (2003). Maturational constraints in SLA. In C. Doughty & M. H. Long (Eds*.), Handbook of second language acquisition*. Oxford: Blackwell.

Iwashita, N., McNamara, T., & Elder, C. (2001). Can we predict task difficulty in an oral proficiency test? Exploring the potential of an information processing approach to task design. *Language Learning, 51*, 401-436.

Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology, 21*, 60-99.

Johnson, J. S., & Newport, E. L. (1990). Critical period effects on universal properties of language: the status of subjacency in the acquisition of a second language. *Cognition, 39,* 215-258.

Johnson, K. (1996). *Language teaching and skill learning.* Oxford: Blackwell.

Jonides, J. (1995). Working memory and thinking. In E. Smith & D. Osherson (Eds*.), An invitation to cognitive science, Vol 3: Thinking* (pp. 217-265). Cambridge, MA: MIT Press.

Karmiloff-Smith, A. (1992*). Beyond modularity: A developmental perspective on cognitive science*. Cambridge, MA: MIT Press.

Kellerman, E. (1985). Input and second language acquisition theory. In S. Gass & C. Madden (Eds.), *Input in second language acquisition* (pp. 345-353). Rowley, MA: Newbury House.

Klein, W. (1989). *Second language acquisition*. Cambridge: Cambridge University Press.

Klein, W., & Perdue, C. (Eds.), (1992). *Utterance structure: Developing grammars again.* Amsterdam: Benjamins.

Klein, W., & Perdue, C. (1997). The basic variety (or: Couldn't natural languages be much simpler?). *Second Language Research, 13,* 301-347.

Knorr, E., & Neubauer, A. (1996). Speed of information processing in an inductive reasoning task and its relationship to psychometric intelligence*. Personality and Individual Differences, 20*, 653-660.

Krashen, S. (1985). *The input hypothesis: Issues and implications.* Oxford, New York: Pergamon.

Larsen-Freeman, D., & Long, M. H. (1991*). An introduction to second language acquisition research.* London: Longman.

Lee, C. E., & Rescorla, L. (2002). The use of psychological state terms by late talkers at age 3. *Applied Psycholinguistics, 23*, 623-641.

Lee, Y.-G. (2000). Effects of degrees of task complexity on L2 production. In S. Kang (Ed.), *Korean language in America 5*. Monterey, CA: The American Association of Teachers of Korean.

Li, P., & Shirai, Y. (2000). *The acquisition of lexical and grammatical aspect*. Berlin: Mouton de Gruyter.

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95*, 492-527.

Long, M. H. (1985). A role for instruction in second language acquisition: Task-based language teaching. In K. Hyltenstam & M. Pienemann (Eds.), *Modeling and assessing second language acquisition* (pp. 77-99). Clevedon, Avon: Multilingual Matters.

Long, M. H. (1989). Task, group, and task-group interactions. *University of Hawai'i Working Papers in ESL, 8,* 1-25.

Long, M. H. (1990). Maturational constraints on language development. *Studies in Second Language Acquisition, 12,* 251-285.

Long, M. H.(1991). Focus on form: A design feature in language teaching methodology. In K. de Bot, R. Ginsberg, & C. Kramsch (Eds.), *Foreign language research in cross-cultural perspectives* (pp. 39-52). Amsterdam: Benjamins.

Long, M. H. (1996). The role of the linguistic environment in second language acquisition. In W. Ritchie & T. Bhatia (Eds.), *Handbook of second language acquisition* (pp. 413-463). San Diego, CA: Academic Press.

Long, M. H. (1998). Focus on form in task-based language teaching. *University of Hawaii Working Papers in ESL, 16*, 49-61.

Long, M. H. (Ed.), (in press). *Second language learning needs analysis*. Cambridge: Cambridge University Press.

Long, M. H., & Crookes, G. (1992). Three approaches to task-based syllabus design. *TESOL Quarterly, 26*, 27-56.

Long, M. H., & Crookes, G. (1993). Units of analysis in syllabus design—The case for task. In G. Crookes & S. Gass (Eds.), *Tasks in a pedagogic context: Integrating theory and practice* (pp. 9-54). Clevedon: Multilingual Matters.

Long, M. H., & Robinson, P. (1998). Focus on form: Theory, research, and practice. In C. Doughty & J. Williams (Eds.), *Focus on form in classroom second language acquisition* (pp. 15-41). Cambridge: Cambridge University Press.

Loschky, L., & Bley-Vroman, R. (1993). Grammar and task-based methodology. In G. Crookes & S. Gass (Eds.), *Tasks in language learning: Integrating theory and practice* (pp. 123-167). Clevedon: Multilingual Matters.

Mackey, A. (1999). Input, interaction and second language development: An empirical study of question formation in ESL. *Studies in Second Language Acquisition, 21*, 557-587.

MacNamara, T. (1996). *Measuring second language performance*. London: Longman.

Malle, B. (2002). The relation between language and theory of mind in development and evolution. In T. Givon & B. Malle (Eds), *The evolution of language out of pre-language* (pp. 265-284). Amsterdam: Benjamins.

Mascha, M. (2001). The effect of task complexity and expert system type on the acquisition of procedural skill. *International Journal of Accounting Information Systems, 2*, 103-124.

Meisel, J. (1987). Reference to past events and actions in the development of natural second language acquisition. In C. Pfaff (Ed.), *First and second language acquisition processes* (pp. 206-225). Rowley, MA: Newbury House.

Merickle, P.M., & Reingold, E.M. (1991). Comparing direct (explicit) and indirect (implicit) measures to study unconscious memory. *Journal of Experimental Psychology: Learning, Memory and Cognition, 17,* 224-233.

Muranoi, H. (2000). Focus on form through interaction enhancement: Integrating formal instruction into a communicative task in EFL classrooms. *Language Learning, 50,* 617-673.

Nembhard, D. (2000). The effects of task complexity and experience on learning and forgetting: A field study. *Human Factors, 42*, 272-286.

Neumann, O. (1987). Beyond capacity: A functional view of attention. In H. Heuer & A. Sanders (Eds.), *Perspectives on perception and action* (pp. 361-394). Berlin: Springer.

Newport, E. L. (1990). Maturational constraints on language learning. *Cognitive Science, 14*, 11-28.

Newton, J., & Kennedy, G. (1996). Effects of communication tasks on the marking of grammatical relations by second language learners. *System, 24,* 159-177.

Niwa, Y. (2000). *Reasoning demands of L2 tasks and L2 narrative production: Effects of individual differences in working memory, intelligence, and aptitude.* Unpublished M.A dissertation, Aoyama Gakuin University, Dept. English, Tokyo.

Norris, J., Brown, J., Hudson, T. & Yoshioka, J. (1998*). Designing second language performance assessments.* Honolulu, HI: University of Hawaii Press.

Nunan, D. (1989*). Designing tasks for the communicative classroom.* Cambridge: Cambridge University Press.

Nunan, D. (1993). Task-based syllabus design: Selecting, grading and sequencing tasks. In G. Crookes & S. Gass (Eds*.), Tasks in a pedagogic context: Integrating theory and practice* (pp. 55-68). Clevedon: Multilingual Matters.

O'Grady, W. (2003). The radical middle: Nativism without Universal Grammar. In C. Doughty & M. H. Long (Eds.), *Handbook of second language acquisition*. Oxford: Blackwell.

Osaka, M., & Osaka, N. (1992). Language-independent working memory as measured by Japanese and English reading span tests. *Bulletin of the Psychonomic Society, 30,* 287-289.

Perdue, C. (Ed.) (1993a). *Adult language acquisition: Crosslinguistic perspectives Vols. 1: Field methods.* Cambridge: Cambridge University Press.

Perdue, C. (Ed.) (1993b). *Adult language acquisition: Crosslinguistic perspectives Vols. 2: The results.* Cambridge: Cambridge University Press.

Philp, J. (2003). Constraints on 'noticing the gap': Nonnative speakers noticing of recasts in NS-NNS interaction. *Studies in Second Language Acquisition, 25,* 99-126.

Pica, T. (1987). Interlanguage adjustments as an outcome of NS-NNS negotiated interaction. *Language Learning, 38*, 45-73.

Pica, T., Kanagy, R., & Falodun, J. (1993). Choosing and using communication tasks for second language teaching and research. In G. Crookes & S. Gass (Eds.), *Tasks in language learning: Integrating theory and practice* (pp. 9-34). Clevedon, Avon: Multilingual Matters.

Pienemann, M. (1998). *Language processing and second language acquisition; Processability theory.* Amsterdam: Benjamins.

Prabhu, N. (1987). *Second language pedagogy*. Oxford: Oxford University Press.

Rahimpour, M. (1997). *Task condition, task complexity and variation in oral L2 discourse.* Unpublished Ph.D dissertation, University of Queensland, Brisbane, Australia.

Rahimpour, M. (1999). Task complexity and variation in interlanguage. In N. Jungheim & P. Robinson (Eds.), *Pragmatics and pedagogy: Proceedings of the 3rd Pacific Second language Research Forum, Vol 2* (pp. 115-134). Tokyo: PacSLRF.

Reber, A. S. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General, 118*, 219-235.

Reber, A. S., & Allen, R. (2000). Individual differences in implicit learning: Implications for the evolution of consciousness. In R. Kunzendorf & B. Wallace (Eds*.), Individual differences in conscious experience* (pp. 227-250). Amsterdam: Benjamins.

Reber, A. S., Walkenfield, F., & Hernstadt, R. (1991). Implicit and explicit learning: Individual differences and IQ. *Journal of Experimental Psychology: Learning, Memory and Cognition, 17,* 888-896.

Reder, L., & Schunn, C. (1999). Bringing together the psychometric and strategy worlds: Predicting adaptivity in a dynamic task. In D. Gopher & A. Koriat (Eds.), *Attention and performance, XVII: Cognitive regulation of performance—Interaction of theory and application* (pp. 317-342). Cambridge, MA: MIT Press.

Reilly, J., Klima, E., & Bellugi, U. (1991). Once more with feeling: Language and affect in atypical populations. *Development and Psychopathology, 6,* 367-391.

Robinson, P. (1986). Constituency or dependency in the units of language acquisition: An approach to describing the learner's analysis of formulae. *Linguisticae Investaigationes, 10,* 417-438.

Robinson, P. (1989). Procedural vocabulary and language learning. *Journal of Pragmatics, 13,* 523-546.

Robinson, P. (1990). Metaphors for the description of acquisition data: From constituency 'trees' to dependency 'frames'. *International Review of Applied Linguistics, 28*, 273-292.

Robinson, P. (1994). Implicit knowledge, second language learning and syllabus construction. *TESOL Quarterly, 28*, 161-166.

Robinson, P. (1995a). Task complexity and second language narrative discourse. *Language Learning, 45***,** 99-140.

Robinson, P. (1995b). Attention, memory and the 'noticing' hypothesis. *Language Learning, 45***,** 283-331.

Robinson, P. (1995c). Aptitude, awareness, and the fundamental similarity of implicit and explicit second language learning. In R. Schmidt (Ed.), *Attention and awareness in foreign language learning* (pp. 303-357). Honolulu, HI: University of Hawai'i Press.

Robinson, P. (1996a). *Consciousness, rules and instructed second language acquisition*. New York: Lang.

Robinson, P. (1996b). Learning simple and complex second language rules under implicit, incidental, rule-search and instructed conditions. *Studies in Second Language Acquisition, 18*, 27-67.

Robinson, P. (1996c). Connecting tasks, cognition and syllabus design. In P. Robinson (Ed.), *Task complexity and second language syllabus design: Data-based studies and speculations: University of Queensland Working papers in Applied Linguistics, Special Issue* (pp. 1-15). Brisbane: University of Queensland, CLTR.

Robinson, P. (1997a). Individual differences and the fundamental similarity of implicit and explicit adult second language learning. *Language Learning, 47,* 45-99.

Robinson, P. (1997b). Automaticity and generalizability of second language learning under implicit, incidental, enhanced and instructed conditions. *Studies in Second Language Acquisition,19*, 223-248.

Robinson, P. (1997c). Giving pushed output a push: The role of task complexity. *Clarion, EUROSLA Newsletter, 3*(2), 22-24.

Robinson, P. (1997d). State of the art: SLA research and language teaching. *The Language Teacher, 21*(7), 7-16.

Robinson, P. (1998). State of the art: SLA theory and second language syllabus design. *The Language Teacher, 22*(4), 7-13.

Robinson, P. (2000). *Task complexity and reasoning demands: effects on dyadic NNS-NNS interaction, fluency, accuracy, complexity and incorporation of input*. Unpublished data, Aoyama Gakuin University, Tokyo.

Robinson, P. (2001a). Task complexity, cognitive resources and syllabus design: A triadic framework for examining task influences on SLA. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 185-316). New York: Cambridge University Press.

Robinson, P. (2001b). Task complexity, task difficulty and task production: Exploring interactions in a componential framework. *Applied Linguistics, 22,* 27-57.

Robinson, P. (2001c). Individual differences, cognitive abilities, aptitude complexes and learning conditions in second language acquisition. *Second Language Research, 17,* 368-392.

Robinson, P. (2002a). Individual differences in intelligence, aptitude and working memory during adult incidental second language learning: A replication and extension of Reber, Walkenfield and Hernstadt (1991). In P. Robinson (Ed.), *Individual differences and instructed language learning* (pp. 211-266). Amsterdam: Benjamins.

Robinson, P. (2002b). Learning conditions, aptitude complexes and SLA: A framework for research and pedagogy. In P. Robinson (Ed.), *Individual differences and instructed language learning* (pp. 113-134). Amsterdam: Benjamins.

Robinson, P. (2002c). The Cognition Hypothesis of task-based language development and its implications for syllabus design. *Acquisition of Japanese as a Second Language, 5*, 142-144.

Robinson, P. (Ed.) (2002d). *Individual differences and instructed language learning*. Amsterdam: Benjamins.

Robinson, P. (2003a). Attention and memory during SLA. In C. Doughty & M. Long (Eds.), *Handbook of second language acquisition* (pp. 630-678). Oxford: Blackwell.

Robinson, P. (2003b). Multiple aptitudes for instructed second language learning. *Journal of Korean English Language and Linguistics, 3*(3), 375-410.

Robinson, P. (in preparation a). Aptitudes, abilities, contexts and practice. In R. DeKeyser (Ed.), *Practice in second language learning: Perspectives from linguistics and psychology*. New York: Cambridge University Press.

Robinson, P. (in preparation b*). Task complexity, second language development and syllabus design.* Ms.

Robinson, P. (in preparation c). Comprehension, cognitive complexity and task-based language production. To appear in S. Nobe, P. Robinson, D. Smith, G. Strong, M. Tani, & H. Yoshiba (Eds.), *Language and comprehension: Perspectives from linguistics and language education*. Tokyo: Soken Research Institute.

Robinson, P., & Ha, M. (1993). Instance theory and second language rule learning under explicit conditions. *Studies in Second Language Acquisition, 15,* 413-438.

Robinson, P., Nobe, S., Strong, G., & Whittle, J. (2001). The development of EAP oral discussion ability. In J. Flowerdew & M. Peacock (Eds*.), Research perspectives on english for academic purposes* (pp. 347-360). Cambridge: Cambridge University Press.

Robinson, P., & Ross, S. (1996). The development of task-based testing in English for academic purposes programs. *Applied Linguistics, 17,* 455-476.

Robinson, P., Ting, S. C-C., & Urwin, J. (1995). Investigating second language task complexity. *RELC Journal, 25,* 62-79.

Robinson, P., & White, R. (1995). Current approaches to syllabus design: A discussion with Ron White. *RELC Guidelines, 17*, 93-102.

Rohdenburg, G. (1996). Cognitive complexity and increased grammatical explicitness in English. *Cognitive Linguistics, 7,* 367-388.

Rohdenburg, G. (1998). Clarifying structural relationships in cases of increased complexity in English. In R. Schulze (Ed.), *Meaningful choices in English: On dimensions, perspectives, methodology and evidence* (pp. 189-205). Tubingen: Gunter Narr.

Rohdenburg, G. (2002). Processing complexity and the variable use of prepositions in English. In H. Cuyckens & G. Radden (Eds.), *Perspectives on prepositions* (pp. 79-101). Tubingen: Gunter Narr.

Rondal, J. (1995). *Exceptional language development in down syndrome: Implications for the cognition-language relationship*. Cambridge: Cambridge University Press.

Rosenberg, S. (1982). The language of the mentally retarded: Development, processes and intervention. In S. Rosenberg (Ed.), *Handbook of applied psycholinguistics*. Hillsdale, NJ: Erlbaum.

Rubinstein, J., Meyer, D., & Evans, J. (2001). Executive control of cognitive processes in task switching. *Journal of Experimental Psychology: Human Perception and Performance, 27*(4), 763-797.

Sachs, J. (1983). Talking about the there and then: The emergence of displaced reference in parent-child discourse. In K. E. Nelson (Ed.), *Children's language: Vol. 4* (pp. 1-28). Hillsdale, NJ: Erlbaum.

Samuda, V. (2001). Guiding relationships between form and meaning during task performance: The role of the teacher. In M. Bygate, P. Skehan, & M. Swain (Eds.), *Researching pedagogic tasks: Second language learning, teaching, and testing* (pp. 119-140). London: Longman.

Sanders, A. (1998*). Elements of human performance: Reaction processes and attention in human skill*. Mahwah, NJ: Erlbaum.

Sarno, K., & Wickens, C. (1995). Role of multiple resources in predicting time-sharing efficiency: Evaluation of three workload models in a multiple-task setting. *The International Journal of Aviation Psychology, 5*, 107-130.

Sasaki, M. (1996*). Second language proficiency, foreign language aptitude and intelligence*. New York: Lang.

Sato, C. (1990). *The syntax of conversation in interlanguage development.* Tubingen: Gunter Narr.

Schaeken, W., De Vooght, G., Vandierendonck, A., & Y'deWalle, G. (Eds.) (2002). *Deductive reasoning and strategies.* Mahwah, NJ: Erlbaum.

Schmidt, R. (1983). Input, acculturation and the acquisition of communicative competence. In N. Wolfson & E Judd (Eds.), *Sociolinguistics and second language acquisition* (pp. 137-174). Rowley, MA: Newbury House.

Schmidt, R. (1990). The role of consciousness in second language learning. *Applied Linguistics, 11*, 129-158.

Schmidt, R. (1995). Consciousness and foreign language learning: A tutorial on the role of attention and awareness in learning. In R. Schmidt (Ed.), *Attention and awareness in foreign language learning* (pp. 1-64). Honolulu, HI: University of Hawaii Press.

Schmidt, R. (2001). Attention. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 1-33). New York: Cambridge University Press.

Schneider, V., Healy, A., & Bourne, L.R. Jr. (2002). What is learned under difficult conditions is hard to forget: Contextual interference effects in foreign vocabulary acquisition, retention, and transfer. *Journal of Memory and Language,* 46(2), 419-440

Schwartz, N. (1996). *Cognition and communication: Judgmental biases, research methods, and the logic of conversation*. Mahwah, NJ: Erlbaum.

Scovel, T. (1988). *A time to speak.* Rowley, MA: Newbury House.

Segalowitz, N. (2001). On the evolving connections between psychology and linguistics. *Annual Review of Applied Linguistics, 21*, 3-22.

Segalowitz, N. (2002). Automaticity and second language acquisition. In C. Doughty and M. H. Long (Eds.), *Handbook of second language acquisition*. Oxford: Blackwell.

Shatz, M., Wellman, H., & Silber, S. (1983). The acquisition of mental verbs: A systematic investigation of first references to mental states. *Cognition, 14*, 301-321.

Sheppard, C. (2000). Designing a task-based syllabus (for the Korean context). *The English Connection: KOTESOL, 4*(3), 1-10.

Shimizu, A. (2003). *Effects of anxiety and individual differences on speech performance in a second language*. Unpublished B.A dissertation, Aoyama Gakuin University, Dept. English, Tokyo

Skehan, P. (1989). *Individual differences in second language acquisition.* London: Arnold.

Skehan, P. (1996). A framework for the implementation of task-based instruction. *Applied Linguistics, 17,* 38-62.

Skehan, P. (1998). *A cognitive approach to language learning*. Oxford: Oxford University Press.

Skehan, P., & Foster, P. (2001). Cognition and tasks. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 181-203). Cambridge: Cambridge University Press.

Slobin, D. I. (1973). Cognitive prerequisites for the development of grammar. In C. Ferguson & D. Slobin (Eds), *Studies of child language development* (pp. 175-208). New York: Holt, Rhinehart, & Winston.

Slobin, D. I. (1993). Adult language acquisition: A view from child language study. In C. Perdue (Ed.), *Adult language acquisition: Crosslinguistic perspectives vol 2: The results* (pp. 239-252). Cambridge: Cambridge University Press.

Snow, R. E. (1994). Abilities in academic tasks. In R.J. Sternberg & R K. Wagner (Eds.), *Mind in context: Interactionist perspectives on human intelligence* (pp. 3-37). New York: Cambridge University Press.

Snow, R. E., Kyllonen, P., & Marshalek, B. (1984). The topography of ability and learning correlations. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence, Vol. 2* (pp. 47-104). Hillsdale, NJ: Erlbaum.

Spilsbury, G., Stankov, L., & Roberts, R. (1990). The effects of a task's difficulty on its correlation with intelligence. *Personality and Individual Differences, 11*, 1069-1077.

Stanovitch, K. (2000). *Who is rational: Studies of individual differences in reasoning.* Mahwah, NJ: Erlbaum.

Stanovitch, K., & West, R. (2000). Individual differences in reasoning: Implications for the rationality debate. *Behavioral and Brain Sciences, 23*, 645-665.

Sternberg, R. (1985). *Beyond IQ: A triarchic theory of human intelligence*. Cambridge:

Cambridge University Press.

Sternberg, R. (1990). *Metaphors of mind: Conceptions of the nature of intelligence*. New York: Cambridge University Press.

Sternberg, R. (2002). The theory of successful intelligence and its implications for language aptitude testing. In P. Robinson (Ed.), *Individual differences and instructed language learning.* Amsterdam: Benjamins.

Swain, M. (1985). Communicative competence: some roles of comprehensible input and comprehensible output in its development. In S. Gass & C. Madden (Eds.), *Input in second language acquisition* (pp. 235-253). Rowley, MA: Newbury House.

Swain, M. (1995). Three functions of output in second language learning. In G. Cook & B. Seidlhoffer (Eds.), *Principle and practice in applied linguistics: Studies in honour of H. G. Widdowson* (pp. 125-144). Oxford: Oxford University Press.

Talmy, L. (2000*). Toward a cognitive semantics, Vol. 1: Concept structuring systems*. Cambridge, MA: MIT Press.

Taylor, H., & Tversky, B. (1996). Perspective in spatial description*. Journal of Memory and Language, 35*, 371-391.

Tomasello, M. (1999). *The cultural origins of human cognition.* Cambrdge, MA: Harvard University Press.

Tomasello, M. (2000). The item based nature of children's early syntactic development*. Trends in Cognitive Sciences, 4,* 122-139.

Tomlin, R. (1990). Functionalism in second language acquisition*. Studies in Second Language Acquisition, 12*, 155-177.

Tucker, P., & Warr, P. (1996). Intelligence, elementary cognitive components, and cognitive styles as predictors of complex task performance*. Personality and Individual Differences, 21*, 91-102.

Urwin, J. (1999). *Second language listening task complexity*. Unpublished Ph.D dissertation, Monash University, Melbourne, Australia.

Urwin, J., & Robinson, P. (1999). The effects of pre-listening tasks on reception and processing. In N. Jungheim & P. Robinson (Eds.), *Pragmatics and pedagogy: Proceedings of the 3rd Pacific Second Language Research Forum, Vol. 2*, (pp. 135-142). Tokyo: PacSLRF.

VanPatten, B. (1990). Attending to form and content in the input: An experiment in consciousness. *Studies in Second Language Acquisition, 12,* 287-301.

Wasow, T. (2002). *Postverbal behavior.* Stanford, CA: CSLI Publications.

Weist, R., Lyytinen, P., Wysocka, J., & Atanassova, M. (1997). The interaction of language and thought in children's language acquisition: A crosslinguistic study. *Journal of Child Language, 24*, 81-121.

Wellman, H. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.

White, L. (2003). On the nature of interlanguage representation: Universal Grammar in the second language. In C. Doughty & M. H. Long (Eds.), *Handbook of second language acquisition*. Oxford: Blackwell.

White, R. (1988). *The ELT curriculum: Design, management and innovation.* Oxford: Blackwell.

Wickens, C. (1984). Processing resources in attention. In R. Parasuraman & D. Davies (Eds.), *Varieties of attention (*pp. 63-102). New York, NY: Academic Press.

Wigglesworth, G. (2001). Influences on performance in task-based oral assessments. In M. Bygate, P. Skehan, & M. Swain (Eds.), *Researching pedagogic tasks: Second language learning, teaching, and testing* (pp. 186-209). London: Longman.

Widdowson, H.G. (1978). *Teaching language as communication*. Oxford: Oxford University Press.

Wilkins, D. (1976). *Notional syllabuses.* Oxford: Oxford University Press.

Willis, D. (1990). *The lexical syllabus: A new approach to language teaching.* London: Collins.

Wimmer, H., & Perner, T. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*, 103-128.

Peter Robinson
Aoyama Gakuin University,
Department of English
4-4-25 Shibuya,
Shibuya-ku,
Tokyo 150-8366
JAPAN.

peterr@cl.aoyama.ac.jp