Appropriation and ontogeny: Identifying compatibility between
cognitive and sociocultural contributions to adult learning and development

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Abstract

On their own, the cognitive psychology and sociocultural constructivist perspectives fails to furnish a complete account of adult learning and development. In the past, these perspectives have been viewed as being incompatible because their origins reside in rival and distinct areas of theorising. This paper seeks to propose a more comprehensive basis for adult learning and development by advancing an initial reconciliation between these perspectives which represent views about the internal processes of the mind and the external influence on cognition. This reconciliation is achieved by identifying areas of commonality and compatibility between these two constructivist perspectives which provides a likely basis to yield a more comprehensive account of adults thinking and acting. It is held that only through an accommodation between social practice and cognition can such an account be realised. Differences between the two perspectives are drawn closer together by current theorising which views individual's appropriation of knowledge as being a socially-mediated, interpretative and contested process. This, along with the concept of ontogeny or life history permits closure between the Piagetian and Vygotskian perspectives as they render key differences compatible. It is advanced therefore that deliberations about adults' construction of knowledge and ongoing development needs to account for the dual contributions of internal processes and external sources provided by both constructivist perspectives.

1. Introduction

Questions about how adults learning and development occurs and from where they source knowledge remains unanswered. Much of the difficulty in resolving such questions resides in the apparent incompatibility between theories which provide separate accounts of the roles of internal processes of the mind and social contributions to cognition. Despite three decades of research within cognitive psychology, it is still not possible to advance an overall picture of mental functioning (Genberg, 1992; Wertsch, 1993). However, in recent years there has been growing acknowledgment that individuals' thinking and acting are influenced by social and cultural sources. The recent acceptance of contributions from sociology and anthropology to cognitive theorising, which has traditionally viewed thinking and acting as being solely the product of the internal workings of the mind is evidence of this acknowledgment (Glaser, 1990; Greeno, 1989a; Pelissier, 1991; Stevenson, 1994). Moreover, the belief advocated by Vygotsky (1978) that knowledge has sociohistorical origins is fuelling further deliberation about the social sourcing and construction of knowledge (Bredo, 1994; Gauvain, 1993; Greeno, 1989b; Lave, 1990; Prawat & Floden, 1994; Rogoff, 1995). Such deliberations provide opportunities for a fresh appraisal of how adults' thinking, acting and development are influenced, and how learning can best proceed. In particular, questions about how social practice influences the construction of adults knowledge remain unresolved. The source of this separate theorising has been a product of the different emphasis in the work of key developmental theorists Piaget and Vygotsky who, respectively, have influenced the development of cognitive psychology and sociocultural theory. In order to advance understanding of adult development, this paper advances an initial reconciliation between the cognitive and sociocultural constructivist perspectives which separately, and respectively, represent views emphasising the internal attributes associated with thinking, and external sources and appropriation of knowledge. Central to what is advanced is that the active process of knowledge construction, referred to as appropriation (Rogoff, 1990; 1995), makes an important contribution to consider how social practice and adults cognitive development may be linked. In addition the concept of ontogeny (Scribner, 1985), the evolving life history of individuals, also provides a platform for compatibility between perspective which privilege developmental aspects of the social and the individual in different ways.

Initially, it is proposed that, on their own, the cognitive psychology and sociocultural constructivist perspectives fail to furnish a comprehensive account of how cognitive activities and development occur. A reconciliation between these two perspectives is advocated to provide a more complete understanding of adults' thinking and acting. To examine links between social circumstances and cognitive structures, the cognitive psychology and sociocultural constructivist theories are reviewed critically using the views of Piaget and Vygotsky, their pupils and recent adherents. In order to commence this reconciliation, an overview of constructivism is presented next, as both perspectives, in the main, subscribe to this view of cognitive development. Areas of similarity and difference are then identified between the Piagetian and Vygotskian constructivist perspectives. , Using complementarity between these perspectives, bridges between these theorists' contributions are proposed as a basis for an initial reconciliation. This complementarity involves examining each perspective's view of: (i) the social contribution to cognitive development, (ii) degree of biological determinism, (iii) whether they are characterised by collaboration or antagonism, and (iv) the degree each theorist acknowledges self-regulation. In conclusion, it is held that although some differences remain there is a sound basis for a reconciliation between these perspectives and this has particular applications to the understanding of how adults' thinking and acting is influenced and, in particular, how they source and construct knowledge. Central to views about adult learning is that the search for viability of knowledge underpins its appropriation by learners and this viability is found within social practice thereby contributing to the ongoing development of the individual (ontogeny).

2 Cognitive and social contributions to thinking and acting

The separate development of cognitive and sociocultural theories has resulted, within cognitive psychology, in the mind being viewed as isolated from the social world (Bredo, 1994). To reduce this isolation, it is necessary to identify links between cognitive and social theory to establish greater certainty about the relationship between the social and cognitive contributions to thinking and acting (Gauvain, 1993, Scribner & Beach, 1993; Wertsch, 1993). Such a task is seen as likely to inform about the nature, potential and limitations of such links and relationships. In the following section the contributions of the cognitive psychology and sociocultural theories and the need for their reconciliation are discussed.

Cognitive psychology provides an account of the construction of individuals' representations of knowledge in memory. Representations are usually viewed as forms of conceptual and procedural knowledge, referred to as cognitive structures or schemata (Piaget, 1968), which are constructed, organised in memory and utilised in addressing both routine and non-routine goal-directed activities. Cognitive structures are deployed in goal-directed activity, such as problem-solving, transfer and learning. Within cognitive psychology, problem-solving is viewed as the process which transforms and extends knowledge (Anderson, 1993; Shuell, 1990). Learning new knowledge is the transformation of existing knowledge through its deployment to other similar or not-so-similar situations, also referred to as transfer, thereby being associated with cognitive development (Anderson, 1993). The effective deployment of cognitive structures in non-routine situations (for example, novel problem-solving and transfer) within a domain of knowledge distinguishes experts from novices (Anderson, 1982; Ericsson & Simon, 1984; Glaser, 1989). Within cognitive psychology, domains of knowledge are viewed as being knowledge associated with an academic discipline or subject matter, held as long-standing truths (Prawat & Floden, 1994). Categorising problems by the means of their solution, another hallmark of expertise, is dependent upon how individuals represent the problem and construct a problem space from which solutions can be secured (Chi, Feltovich & Glaser, 1981; Glaser, 1984). The problem space is the solver's representation of the problem (Newell & Simon, 1972), which is dependent upon the adequacy of individuals' cognitive structures. So the view within cognitive psychology is that knowledge construction and cognitive development occur through problem-solving (both routine and non-routine) which is cognitive activity associated with learning new knowledge (Anderson, 1993; Shuell, 1990) and transfer. In sum, this perspective views thinking as a skill (Sternberg, 1989), the effectiveness of which is determined internally by the extent and organisation of individuals' cognitive structures.

However, the cognitive perspective remains incomplete, as it fails to identify sources of representations of knowledge, illuminate how these sources influence the characteristics of the representations of knowledge in memory or advance a comprehensive account of how they are constructed (Billett, 1996a).

The sociocultural perspective provides an account of the social genesis and construction of knowledge. Within this view of knowledge construction and cognitive development, the contributions of both immediate interpersonal interactions (Vygotsky, 1987) and more distant social and cultural contexts (Scribner, 1985) are emphasised. Learning is viewed as the appropriation of socially derived forms of knowledge. Appropriation is the process of constructing knowledge from social and cultural sources, mediated by individuals' idiosyncratically structured knowledge (Rogoff, 1990; 1995). So, as this definition implies, appropriation is not the mere internalisation of externally derived stimuli (Rogoff, 1995), instead consisting of individuals constructing their own versions of knowledge (Leonteyev, 1981). Moreover, appropriation involves a reciprocal transformation of both the subject and object. Not only is individuals' knowledge transformed, but also how they perceive and represent the source of the stimuli is transformed. The book read may lead to transformation of the reader's knowledge, but equally how the book is viewed by the reader is also transformed. Therefore, sociocultural theorising provides a view of knowledge construction emphasising the mutuality between persons acting and the social and cultural circumstances in which has they act, which has been termed the co-construction of knowledge (Lawrence & Valsiner, 1993). This view holds that the origins and constraints of knowledge construction are necessarily socially determined as co-construction includes negotiating a socially-determined source. However, on its own, sociocultural theory fails to provide a comprehensive account of the different types of knowledge which are constructed or how these are deployed in goal-directed activity. Yet, arising from these perspectives are contributions which are both common and complementary.

By tradition, both of these constructivist perspectives have distinct preferences for inquiry (Glassman, 1994). For example, early work in cognitive psychology favoured positivist experimental forms of inquiry, something not lost its on critics (Garner, 1990; Newman, Griffin & Cole, 1984; 1989), who argue that, by stripping away important variables from the particular circumstances, inquiry becomes disembodied from applications of that knowledge. This shortcoming becomes evident when what is determined under controlled conditions is not sustainable in everyday applications (Wertsch, 1993). In contrast, sociocultural theorising draws upon ethnographic-type studies of societies and cultures. Recently, the social and cultural contributions to thinking have become accepted within cognitive psychology (e.g. Brown,

Collins & Duguid, 1989; Collins, Brown & Newman, 1989). This acceptance has contributed to breaking the isolation of cognitive psychology from the 'lived-in' world. Having cast off the deterministic nature of behaviourism and accepted the importance of cognitive structures and processes, cognitive theorists are now seeking to understand the relationships between internal processes of the mind and social and cultural sources.

3 CONSTRUCTING KNOWLEDGE

The recognition that learners play an active role in their cognitive development has helped displace behaviourist views that learning is something akin to an empty vessel being filled with knowledge that enables performance. This recognition has resulted in the broad acceptance of constructivism (Prawat & Floden, 1994). Both the cognitive psychology and sociocultural theories, in the main, share constructivist views of human development and, consequently, areas of commonality. This commonality offers an initial basis for reconciliation.

3.1 Commonality within the constructivist views

In sharing the constructivist view, the active and interpretive nature of knowledge construction, the search by learners for viability of their knowledge and the initial idiosyncratic structuring of knowledge are commonly held by the two perspectives. Both constructivist views emphasise active and interpretative knowledge acquisition, as individuals integrate and extend their knowledge in an effort to maintain its viability (Piaget, 1980; Vygotsky, 1978). From a constructivist perspective, viability of knowledge is defined in terms of a 'fit' between the existing internal organisation of individuals' knowledge, based on previous learning and dispositions, and their ongoing interaction with the world (von Glasersfeld, 1987). This process is analogous to Piaget's (1968) concept of learners seeking to secure equilibrium when confronted by novel stimuli. Individuals seek to 'make sense' of what they experience. Therefore, viability includes the idea that learning is the process of overcoming an impasse or perturbation - or, as Van Lehn (1988, p. 32) suggests, if there is no impasse, then there is no learning, something about which both Piaget and Vygotsky would be in agreement. The social activity theorist Leonteyev (1981) refers to learners making knowledge 'their own', which is also analogous to Piaget's concept of achieving equilibrium through assimilation and accommodation.

Both the cognitive and sociocultural constructivist views of learning propose that, initially, the construction and organisation of knowledge is individual or idiosyncratic. According to sociocultural views, different interpretations are an inevitable product of any social encounter. If interpretations were identical, there would be little need to communicate (Newman et al., 1989), consequently, the need for communication among individuals provides evidence of the interpretative nature of knowledge construction. Both Piaget (1980) and Vygotsky (1978) accept a social basis for cognition, although the latter emphasises this basis in a distinct way from the former. According to the Vygotskian view, it is through social mediation that knowledge becomes viable and refined, leading to a greater coherence. Yet this idiosyncraticity does not imply a chaotic ordering which impedes communication with others. Only when individuals' concepts manifestly clash will they fail to be compatible enough to form a basis of communication (The Cognitive Technology Group at Vanderbilt [CTGV], 1991; von Glasersfeld 1987). The sociocultural view also holds that, this construction and coherence is patterned by particular social circumstances, both through social mediation (Vygotsky, 1978) and the securing of socially determined goals (Scribner, 1985), rather than the more objective conceptualisation proposed within cognitive psychology (Bredo, 1994). Piaget holds that social interaction merely provides opportunities for equilibrium through the facility of inter-individual (within the individual) activities thereby the individual "regains its autonomy at the very core of social life"(1950: 163). He proposes that the human development cannot come only through co-operation as this would make the individual dependent upon co-operation. Therefore, while agreeing on there being a social basis for cognition its salience remains distinct in these theorists' views.

To depict the process of knowledge construction, and attempting to reconcile these views, consider individuals constructing an understanding about a piece of equipment, by observing and hearing about it. The task of understanding the purpose and operation of the equipment is likely to be different among learners, given each individual's prior knowledge and experience (Posner, 1982). Understanding might be similar in terms of the equipment's function when that function is highly visible, whereas understanding may differ about areas of the equipment's operation which might be opaque. For instance, one individual's representations about the operation of

pistons might be derived from a textbook diagram; while another's representations might have originated from using a bicycle pump. Whereas discussing the function of the equipment may not reveal differences, a more detailed interchange about its operation may reveal differences in understanding. That difference might be based on a range of factors, for example, a misunderstanding about what actually makes the equipment operate. Such a situation could be resolved by providing further access or insights which help establish a 'fit', to render the representations viable. Understanding might also be based on experience with critical factors of operation. In this circumstance, assurances that a particular component is not troublesome are unlikely to be accepted as viable by an individual whose experience with that component has been one of constant breakdowns. This example suggests that the idiosyncratic structuring of knowledge is made coherent through social interaction, with the basis of that coherence being founded on the particular circumstances which demonstrate the viability of that knowledge, rather than being shaped by an objective body of 'given' knowledge about the equipment. Only through social interaction is it likely that congruence will be achieved among individuals. Moreover, as Vygotsky (1987) holds, ongoing participation in social practice where such opportunities occur allows access to close social mediation as well as more distal forms of social influence such as observations, the organisation of activities and declaration of goals will assist in providing coherence (Billett, 1996b; Rogoff, 1990).

For such reasons, the sociocultural view sees knowledge construction as being patterned by the social and cultural circumstances in which knowledge is experienced and mutually transformed. A set of levels of social practice is identified in this literature which includes the evolving historical source of knowledge (phylogenetic), sociocultural practice (sociocultural), individuals' life histories (ontogenetic) and the moment-by-moment knowledge construction (microgenetic) through social practice (Rogoff, 1990). Key among the social circumstances for accessing and constructing knowledge, and hence cognitive development, are the socially and culturally derived norms of a community of practice (Lave, 1990; Lave & Wenger, 1991) where goal-directed activity is undertaken. A community of practice is defined as a set of relations among persons, activity and world, over time and in relationship with other tangential and overlapping communities of practice (Lave & Wenger, 1991, p. 98). The complex of social factors which constitute, maintain and advance the community is conceptualised as an activity system

(Engestrom, 1993; Leonteyev, 1981). A culture of practice refers to norms and practices of the community's activity system which collectively distinguish the community of practice (Brown et al., 1989) and likely, make it unique. These norms are central to the conduct of and participation in goal-directed activities and need to be accounted for in understanding the development and deployment of knowledge. Moreover, these norms determine and inform judgements about what constitutes expertise in these communities (Billett, 1995). This view of expertise suggests that factors beyond the skilful deployment of cognitive structures within disembedded domains of knowledge, as proposed within cognitive psychology, are important for identifying and judging complex thinking activity. Instead, there is a situatedness to expertise which cannot be accounted for by the application of universal cognitive attributes or reference to generic domains of knowledge. Rather, the sociocultural perspective provides multiple levels and complexes of social structures to understand the sourcing and construction of knowledge.

Traditionally, cognitive psychology views knowledge construction as being more individual and idiosyncratic, organised through representations of knowledge in memory, which are the product of the internal workings of the mind. For example, within the information-processing orientation of cognitive psychology there are claims that individuals' constructions result in similar cognitive structures (Simon, 1978), that knowledge is 'given' and domains of knowledge are linked to objective entities such as academic disciplines, laws of science, etc. Moreover, although much of the focus of research within cognitive psychology over the past twenty years has been concerned with novice-expert differences (Glaser, 1990), there is still a lack of a coherent account of how the cognitive development from novice to expert occurs (Genberg, 1992). Therefore, while emphasising individual development as an unfolding of biological attributes (Minsky, 1980) this perspective fails to provide an adequate account of how this development occurs. It is postulated that a component of this incomplete account is the failure to account for the situated nature of cognition and the remoteness of 'objective' knowledge from securing goals in social practice.

In this brief overview of cognitive and sociocultural constructivist views, it is advanced that, over time, idiosyncratic knowledge structures become patterned and more richly associated with external stimuli, which in turn strengthen the organisation of knowledge. These rich associations

render the recall and deployment of knowledge effective. Sociocultural theory focuses on the patterning of knowledge through social sources. In particular, it is held that appropriation relates to microgenetic development, the moment by moment learning which comprises routine and novel problem-solving which leads to individuals' ontogenetic development (Rogoff, 1990). Conversely, cognitive theory favours a more singular, objective basis for the construction and organisation of knowledge. While this review has identified areas of commonality it has also foreshadowed areas of difference which provide foci during attempts to reconcile further these perspectives. To do this, the orientation of two theorists who most reflect these different views, Piaget and Vygotsky, are discussed in order to determine the prospect for further reconciliation.

4 PIAGETIAN AND VYGOTSKIAN CONSTRUCTIVIST PERSPECTIVES

The Piagetian and Vygotskian perspectives are commonly recognised within the constructivist orientation of learning and cognitive development (Casey, 1991; Glaser & Bassok, 1989; Rogoff, 1990), and exemplify the cognitive psychology and sociocultural constructivist perspectives, respectively. On its own, each perspective makes valuable contributions to understanding cognitive development (Glassman, 1994). However, the areas of commonality outlined above suggest the potential for further reconciliation, as the separate emphases on the internal and external contributions to thinking and acting, taken together, offer the prospect of a more coherent account of cognitive development and appear to resolve weaknesses in both these perspectives.

Nevertheless as foreshadowed above, despite these similarities, views about how knowledge is sourced and organised appear to differ between the two constructivist perspectives. Table 1 illustrates these points of difference which are drawn from a synthesis of both literatures

Table 1
Differences in Piagetian and Vygotskian constructivist perspectives

The Piagetian view emphasises:	The Vygotskian view emphasises:
higher-order thinking being biologically-determined;	higher-order thinking having a social and socio historical genesis with the appropriation of sociohistorically derived knowledge includes implicit structures and values;
stages of development determining the application of knowledge and cognitive development with learning being constrained by stages of development;	the development of cognitive structures preceding cognitive development with learning making cognitive development possible; inter-individual interaction leading to intra-

the individual's intra-psychological activity of seeking equilibrium (antagonistic); and	psychological development (collaborative); and
the acquisition of knowledge being self-regulated.	appropriation being active, interpretative, contested and self-regulated.

Firstly, each perspectives emphases on the social contribution to cognitive development are seen as being different (Confrey, 1991; Rogoff, 1990; Tudge & Winterhoff, 1993). Secondly, the degree of biological determinism afforded in their theories (Tudge & Winterhoff, 1993) differs, that is, whether cognitive development is a precursor to (Piagetian), or dependent on, knowledge (Vygotskian). Thirdly, these perspectives differ on whether cognitive development is an antagonistic or collaborative process (Glassman, 1994). Fourthly, the degree to which these perspectives hold learners to be self-regulated is also different. Although distinct, the bases for these differences are interrelated. In the next section, these differences are examined and discussed to identify, in more detail, potential for reconciliation. In overview it is held that the nature of these differences are not irreconcilable and the concepts of appropriation and ontogenetic development also some differences are more about characterisation than being actual. These factors together are key to this reconciliation and characterise the complementarity between the two constructivist perspectives.

(i) Social contribution to cognitive development

Piaget and Vygotsky both acknowledge social factors' contribution to cognitive development. However, there are differences in emphasis and the salience of social factors in their theorising. A question which characterises differences between the two perspectives is whether history is a necessary, but not sufficient, cause of development. Piaget supports the view that history is not on its own sufficient focussing on biological contributions (Inhelder & Piaget, 1958), whereas Vygotsky (1978) privileges the role of history in the sourcing and transformation of knowledge. Cognitive development from the Vygotskian view is premised on social interaction which results in the appropriation of historically-derived, socioculturally-determined knowledge (1978), referred to as an inter-psychological (between social partners) process which leads to intra-psychological outcomes(internal attributes) (Vygotsky, 1978). Appropriation is likened to Piaget's concept of the intra-individual process (interiorization) during knowledge construction (1980). An outcome of appropriation is that individuals 'internalise' the values and organising knowledge structures of the particular culture which include implicit understanding (Confrey,

1993). However, as stated above, Rogoff (1995) holds that appropriation and internalisation are not synonymous. She states that internalisation implies the passing of external knowledge, intact, from the outside to the inside, whereas appropriation is premised on individuals actively interpreting externally sourced knowledge and "gaining facility in an activity" (Rogoff, 1995, p. 15). Appropriation is, therefore, not simply the enculturation of learners who are helpless to resist. Thus Rogoff's view incorporates an internal (cognitive) process as part of appropriation. Piaget (1950) emphasises the intra-psychological over the inter-psychological process referring to social factors as being one of three principles which underpin cognitive development. These principles are (i) the maturation of the nervous system, (ii) experience acquired in interaction with the physical environment and (iii) influence of the social milieu (Inhelder & Piaget, 1958: 243). So, although Piaget acknowledged the significance of social interaction in cognitive development, he does not emphasise the social contribution to knowledge, instead privileging intra-psychological (internal) processes. Thus, while much of what has recently been proposed by von Glasersfeld (1987) is consonant with Piaget's (1968) concept of equilibrium (as learners attempt to integrate new information with what they already know and understand), it seems this explanation is not yet complete and can be advanced by adopting the concept of appropriation advocated above. However, this is not be wholly inconsistent with Piaget's (1950) acceptance of the role of social factors as, for instance, he advocated that at different stages in children's development they are more likely to be influenced by social factors. What he proposes is that children are influenced in different ways by social factors and that later in their development social factors made more salient contributions. A greater consideration of the contribution of social and cultural circumstances, both those immediately associated with appropriation of knowledge and those which comprise individuals' personal histories - their ontogenetic development would seem to be not wholly inconsistent with Piagetian theory.

Moreover, differences in emphasis afforded to the social origins of cognitive development between the Piagetian and Vygotskian perspectives appear to be partially resolved by the view that appropriation is not the mere internalisation of socially determined knowledge, but rather an interpretative and mutually transformative construction of external stimuli. This makes the gap between the two perspectives more assailable, as it addresses Piaget's concerns about individuals seeking equilibrium in an active way, rather than internalising externally-sourced stimuli.

Bridging this gap seems more likely when it is added that both perspectives view the processes of seeking equilibrium (Piaget, 1968; Piaget & Inhelder, 1973), viability (von Glasersfeld, 1987) or problem-solving (Anderson, 1993), as being similar, recognising links between these processes and cognitive development. These processes are commonly concerned with overcoming an impasse which is socially shaped, but lead to solutions which, although initially interpretatively constructed, have cognitive consequences. Thus, it seems that cognitive development encompassed in both perspectives has both cognitive (internal) and social (external) aspects which are closer than is commonly accepted.

(ii) Degree of biological determinism

Piaget (1968) referred to cognitive development in terms of stages linked to biological growth, with each stage permitting increasing levels of complexity in the general application of cognitive processes. Vygotsky argued that biological growth is but one level of his socio-historical view (Scribner, 1985), in which social processes have primacy with, for example, all higher order thinking being generated from socio-historical sources (Vygotsky, 1987). Learning is development and, as such, plays the central role in development from a Vygotskian perspective (1978) whereas Piaget stated development preceded learning. Piaget's theory of stage development has been challenged by the growing recognition of the domain-specificity of knowledge, with claims that phases of development does not result in the generation of universally applicable forms of knowledge (Glaser, 1989, 1990). Also, the failure of general applications of knowledge to be upheld (Carey, 1984; Chi, 1978; Rogoff & Gauvain, 1984) weakens his claims. So, whereas Piaget argued that the development of necessary cognitive structures as a precursor to stage transition and learning, Vygotsky (1978) claims that learning precedes, and makes possible that development.

As stated above, Vygotsky viewed biological growth (ontogenetic development) as being only aspect of the process of cognitive development (Rogoff, 1990). Leonteyev (1981) also challenges the Piagetian view of cognitive development being solely the product of individuals' biological development, by proposing that learners cannot and need not reinvent the cultural artefacts and tools that have taken millennia to develop. The appropriation of the implicit structures of socially organised knowledge removes this need. Davydov (cited in Confrey, 1993)

refers to this as avoiding the epistemological adventures of Robinson Crusoe, as embedded knowledge removes the need to construct independently the tools and concepts of everyday living. Using these arguments it becomes difficult to sustain that constructivism is the mere unfolding of biological development.

It appears that individuals' ontogenetic development are socially developed and have a mediating role in the initial idiosyncratic construction of knowledge (Billett, 1995). This development has biological, personal (individual) and social dimensions, suggests that the distinction between the constructivist perspectives might again, be reconcilable. Thus, the embedding of socially-derived knowledge during ontogenetic development, links between biological development and cognition. So, although one perspective emphasises biological growth more than the other, both theorists acknowledge a role for evolving experiences which have associations with biological growth during engagement in social practice. This does not seem incompatible with Piaget's view. Furthermore, although Piaget's analysis of biological developmental stages did not extend into adulthood, as mentioned above he held that social factors are likely to play a greater role as biological development continues (1950).

(iii) Collaboration or antagonism

As indicated in Table 1, Piaget (1968) proposed that individuals seek to secure equilibrium between antagonistic viewpoints in order to generate viable knowledge. Conversely, Vygotsky (1978) views knowledge as being collaboratively constructed, inter-psychologically, through a process of joint problem-solving and decision-making. Thus, the construction of knowledge is viewed as the product of interaction between individuals' prior knowledge and socially derived knowledge. So, as Piaget would also argue, it is likely that learners will contest and challenge externally-derived knowledge, as they attempt to establish equilibrium between their current knowledge and what they experience (1950). Yet, although appropriation is collaborative, it is a negotiated and transformational process, in which individuals trial and contest their knowledge with others (CTGV, 1991). Indeed, novices seek evidence of viability from other participants in communities of practice (Lave & Wenger, 1991). The contestation associated with appropriation is likely to be stronger when existing understanding and beliefs are challenged. This contestation appears to be analogous to what Piaget proposes as the transformation of existing cognitive

structures, beyond the assimilation of stimuli into existing structures, leading to the construction of new structures through accommodation of the stimuli (Inhelder & Piaget, 1958). Consequently, appropriating knowledge is problematic, rather than benign (Goodnow, 1990; Grusec & Goodnow, 1994), emphasising that knowledge is not 'given', but is actively constructed, interpreted and represented by individuals. Therefore, Vygotsky's claims about collaboration need to be refined to include contestation therefore removing unnecessary distinctions between collaboration and antagonism, thereby accommodating Piaget's view. In these ways, the distinction of collaboration versus antagonism between the two views may be of one of characterisation rather than real difference.

(iv) Degree of self-regulation

The Piagetian perspective is often claimed to place a greater emphasis on learning being self-regulated and intra-individual (within the individual) (Piaget, 1971), as the basis to manage disequilibrium through a protective regulation of accommodation and assimilation, whereas Vygotsky (1978) viewed learning as being social or inter-individual (between individuals), thereby emphasising interaction between cognitive and social activity. However, this distinction may also be overemphasised because, as Rohrkemper (1989) claims, the active and constructive nature of development is also self-regulated, as its problematic nature suggests. Indeed, the contestation that is characterised by the interpretive nature of appropriation, as defined above, adds strength to Piaget's contention that individuals exercise self-regulation.

So, although there remains distinctions between the two constructivist perspectives, there are also areas of commonality. These distinctions may be more in their characterisation than in reality. Both perspectives view development as being triggered by the social world that individuals inhabit (Inhelder & Piaget, 1958; Piaget, 1950; Vygotsky, 1978), and see it as a qualitative transformation of thinking, rather than a mere quantitative addition to thinking, with the pace of that development influenced by social circumstance. The key difference seems to reside in the degree to which each claims that historically-derived social practice plays a role in the development of new cognitive structures and hence, development (Glassman, 1994). However, the concept of appropriation now provides a basis for reconciling these views by providing an account of knowledge construction and adult development by encompassing the

mediation of social and cultural sources in cognitive development, which also acknowledges internal transformations. Equally, individuals' ontogenies, as products of ongoing engagement in goal-directed activities, provides links among social practice, individual development and biological growth.

In sum, the strength of incorporating socio-cultural constructivism in conceptualisations of adults' cognitive development lies in the concept of appropriation, as individuals interpretatively construct patterned representations of historically derived knowledge from socially derived norms and practices such as a communities of practice in which adults participate in goal-directed activity. These communities comprise the workplace, the home, social or recreational settings etc.. The process of appropriation transforms knowledge from initial idiosyncratic structuring to something which is socially patterned by proximal (close) and distal (distant) forms of guidance (Rogoff, 1990, p. 150). It is held that, ongoing social mediation results in the greater congruence of individuals' knowledge, as the personal histories and experiences of individuals are integrated within social practice (Newman et al., 1989).

5. Conclusion

From the analysis of the constructivist perspectives, areas of compatibility identified between the two literatures appear to provide a basis for robust theorising about adult development. This compatibility is premised on linking theories which are often viewed as distinct and rivals thereby emphasise both social and internal contributions to cognition. Distinctions between social sources and cognitive consequences are questioned in this analysis; rather it is advanced that interaction between the social world and the individual's thinking are necessary to understand how adults think, act and develop. Therefore, no longer is it possible to consider adults' construction of knowledge without accounting for social contributions. Given that social circumstances and guidance are held as being integral to the construction of knowledge and securing its viability, this suggests that both the inter-psychological contributions of the social circumstances where knowledge is encountered will be a significant consideration for adult learning. Hence, the circumstances in which adults encounter stimuli, but more particularly engage in goal-directed activity will have cognitive consequences, albeit one that are interpretatively negotiated and constructed. So when congruence of outcomes are desirable,

unless viability can be secured and guidance provided, the intra-psychological outcomes of adults' learning may remain idiosyncratic. Also, given the nature of the ongoing mediation of knowledge and its contribution to adults' ontogenies, it is possible to propose that without ongoing participation in social practice where this knowledge can be accessed and appropriate guidance provided that learning outcomes are likely to be inhibited. For example, studies of learning in workplaces have found that workers in coalmines, secondary processing plants and other industries report the benefits of everyday participation in workpractice to be more beneficial in constructing vocational knowledge than formal modes of instruction (Billett, 1993, 1994, 1996b). It seems that by engaging in goal-directed activity guided by social partners and the physical environment that the transformations of knowledge required for cognitive change or development are secured.

However, there remain areas which require further analysis and reconciliation. The degree to which the social construction of knowledge influences its structuring and deployment requires further investigation. A resolution of this latter impasse is important as it will advance understanding of how and in what ways social circumstances adults shape cognitive activity and development. As the nature, characteristics and organisation of knowledge represented in memory are closely associated with complex performance and adults' cognitive development, some closure of this gap should provide a basis to understand further complex and non-complex forms of thinking and acting.

The view of adults' appropriation of knowledge proposed here provides an account which is interpretative, contested, and necessarily involves mutuality between learners and the social sources. Circumstances in which knowledge is constructed and the guidance available in those situations are likely to be important considerations in planning, implementing and evaluating learning experiences for adults. Hence, both cognitive and social contributions to adult learning and development need to be acknowledged. This then forments a broader discussion about how adult learning and development needs to be conceptualised. Taken, together the constructivist concepts of appropriation and viability emphasise both person-dependent (ontogenetic) and socially-determined contributions (communities and sociocultural practice) which need to be accounted for more fully in theories of adult learning and development.

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