

Piaget, Vygotsky and the cultural development of the notions of *possibility* and *necessity*: Experimental study among rural South African learners.

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1. Introduction

There has been enormous interest within developmental psychology scholarly circles in South Africa in the 1990s on the potential of the discipline to illuminate on the problems of schooling, more specifically the problems of poor academic performance among Black African students within the country's schooling system. Most of these studies applied Piaget or Vygotsky's theories, or both, in the quest to address the practical problems of poor academic performance and the perceived cultural-psychological differences between the more westernized, mostly 'white' children on the one hand and the mostly indigenous black, African students on the other hand (Moll, 1994; Craig, 1989a; 1989b; 1987; 1985; Craig & Miller, 1984; Macdonald, 1987). Studies that emphasized Piaget's framework have mostly suggested that the source of poor academic performance among culturally diverse African students was their cultural diversity, a diversity that produces a lag in cognitive development and functioning (Macdonald, 1987; Craig, 1989a; 1989b). Most of these studies further made recommendations that were consistent with the majority of similar studies in the Piagetian and neo-Piagetian traditions, suggesting that non-Western children manifested a lag in their performance on the Piagetian tasks (for details see Buck-Morss, 1975; Dasen & Heron, 1992).

Even those studies that did not make cross-cultural comparison of the results, such as Levert and Jansen (2001), suggested non-attainment of Piagetian concepts at the appropriate age range posited in the theory by Black South African learners. Levert and Jansen (2001), using Luria's

neuropsychological tasks and Piaget's tasks (p.3), argued that seven year old Black learners from the township of Alexandra, studying in Johannesburg's northern suburbs, identified by their teachers as having 'learning problems', had not achieved concrete operational stage because they did not perform competently on the Piagetian tasks presented during the experiment (Levert & Jansen, 2001, p.27). Even the children from a comparative group coming from the same background, who had been identified as having no learning problems, were found not to have fully attained some of the cognitive skills such as conservation, classification and seriation, leading the researchers to conclude that these group was at an "intermediate level" of development towards concrete operations (Levert & Jansen, 2001, p. 26).

Attempts to link developmental questions with neurological conditions such as carried out in Levert and Jansen (2001) do not however seem to be consistent with the developmental approach in Piaget's framework and has the potential of erroneously locating developmental problems within human biological conditions. Studies that reduced questions of cognitive development and sociocultural or school performance to biological and genetic questions have received extensive review by Kamin (2006). According to Kamin (2006) these studies claimed that Africans were genetically deficient in their intelligence and reasoning abilities when compared to their European counterparts. The differences in intelligent quotient (IQ) tests scores were attributed to "genetic causation" despite the overwhelming evidence in the same studies—illustrated by Kamin, of the cultural bias in the content and methodologies these studies employed (Kamin, 2006, p.7).

Development and mental functioning, in Piaget's sense, is not reducible to biological or maturational processes. Development is a universal process whose manifestation might vary in

relation to the social and cultural contexts of their manifestation. That is, the achievement of conservation of quantity or number concept, for instance, is a universal process common to all humans although their manifestation may differ according to the specific content of the culture to which thought processes are applied. The question of genetic explanation, as much as the maturational factors, cannot therefore provide sufficient basis for an adequate account of developmental achievement and cognitive functioning. More importantly, the fundamental theoretical question in Piaget's framework involved the universality of these developmental processes and not the question regarding the pace of development, which was considered a subordinate question and a quantitative aspect of development. Unfortunately, cross-cultural research inappropriately fore-grounded and elevated—contrary to Piaget's original theoretical position, the question of the developmental pace and its associated notion of developmental lag, and hence the quantitative aspect of the question of development.

For some South African developmental psychologists, Vygotsky's tradition offered a potential pathway for overcoming explanations that located the apparently poor performance of culturally diverse children perpetually on a hind leg. Vygotsky's framework suggests that culture constitutes concrete manifestation of human social processes and historical development. This cultural development of thinking processes is in turn assumed to be a universal process leading to common socio-historical goal involving the attainment of higher, socially more advanced forms of thinking and relational processes such as those characteristic of formal school knowledge and learning (see Wertsch & Tulviste, 1981; Matusov, 2007).

For Vygotsky, cognitive performance in general and learning in particular, is not solely dependent on internally determined, spontaneously occurring developmental processes. It is

fundamentally dependant on appropriately organized forms of social relations and educational interventions (Vygotsky, 1981). Piaget's theory was at times assumed to suggest that development involved the gradual manifestation of internal capabilities, with little contribution of social and cultural processes such as education and language (see Anne-Nelly Perret-Clermont, 1997 for this discussion). However, this is an error that needs to be corrected if we are to find effective ways of accounting for learners' learning and development as a dialectical process that involves the two; internal and external processes dialectically, without reducing one to the other (Vygotsky (1981; 1978; Wertsch, 1985). To this effect, Piaget has argued that learning may play a part in the self-regulatory process involved during development, without however superseding this fundamental internal process:

The hypothesis of a formative action of education by adults certainly contains a part of the answer. Indeed, even from the perspective of the general coordination of actions ..., the adult, being more advanced than the child, can help him to speed up his development during educational processes in the family or in the school ([Piaget, 1966, p.307).

However, most South African studies that have applied Piagetian and Vygotskian frameworks have tended to integrate these approaches, but such integration seems to suggest that Piaget's theory only accounts for the internal self-regulatory processes while Vygotsky's theory focuses on the explanation of the external regulatory processes (see Craig, 1987). A view of these respective theoretical traditions as concerned with a common, irreducible object, namely; the explanation of the internal, psychological processes tends to be lost. These studies, therefore, while employing both frameworks as complementary, seem to suggest a view of the two theoretical traditions as concerned with disparate aspects of human psychological processes. For example, Craig posits that:

[...] The ‘knowing subject’ viewed as an active, purpose-seeking instrument of praxis (from the Piagetian paradigm in cognitive studies) and the internalized, historically and culturally rooted, social forms, communication, and symbols (from the Vygotskian paradigm in cognitive studies) become a legitimate explanatory focus in an analysis of the necessary conditions for change (Craig, 1987, p.78).

The present paper argues that the two theoretical paradigms are, respectively, concerned to explain a single explanatory object, internal (-ized) self-regulatory psychological processes. However, as correctly stated in Craig’s (1987) account, they emphasize different—internal versus external, aspects of what should be the same process; human psychological development. Therefore, these theoretical frameworks should necessarily work complementarily to elaborate on and adequately account for the complex human processes of learning and psychological development. There is therefore a need to work complementarily with both traditions, conceiving of the knowing subject as both active, purposeful and culturally rooted—at one and the same time, rather than conceiving of the subject’s actions as involving two essentially separate processes, one internally driven and biological and the other external and located in human culture and social relations. In this way, psychological processes are conceived as involving both the regulatory functions constituted within human internal coordination of actions as well as the externally determined, other-regulation of actions by society and culture—irreducible to one or the other of the two aspects.

2. Theoretical Background

In South Africa, experimental studies have often found that subjects within the non-western, non-industrialised and non-schooled communities generally perform poorly on tasks, or lag

behind their more westernised counterparts (e.g. Moll, 1994a; Craig, 1985; Macdonald, 1987; Kok, 1986). For example, in a study based on Wertsch (1984), Craig (1985), Graig and Miller (1984) examined the cultural origin of the dyadic patterns between Zulu mothers and their pre-school children. In this study Graig and Miller (1984), Craig (1985) found that the dominant interactional structure followed a culturally derived pattern. For example, Zulu mothers in the study demonstrated what is referred to as the “field dependent behaviour” whereby children were expected to do global imitations of the mothers’ models (Craig, 1985). This instructional method may be deemed as constituting an inefficient problem-solving strategy because it may be at variance with the methods that dominate in other, particularly western cultural traditions.

In the interpretation of the results of these study, Craig and Miller (1984) argue that the interactional patterns of the mothers could be regarded as deficient if the focus of analysis was on what they were not doing relative to their American counterparts in Wertsch’s study which they replicated, or could be interpreted as rational, given the manner in which they construed the goal of the task; “as the specific placement of particular pieces in their correct position” (Craig and Miller, 1984: 20). According to Craig and Miller (1984: 20), the Zulu mothers appeared to be teaching their children to do the task “with them”, while the American mothers in Wertsch’s study appeared to be teaching children to do the task “without them” (Craig and Miller, 1984, p. 20). This study suggests different, culturally derived modes of child rearing practices, and consequently learning and development. This study suggests that the different, culturally derived modes of learning and cognitive development could be compared cross-culturally, with the possibility of the Zulu modes ranked below that of their American counterparts and therefore deficient.

The socio-culturally different patterns of thinking and problem solving consistent with those found in Craig (1985) and Craig and Miller's (1984) studies were reported in several other studies in South Africa. Van Vlaenderen (1999) found, with regard to a group of African young adults participating in her study, that their "epistemic assumptions" and "concepts of problem solving" involved the perception of knowledge as "situationally bound", emphasizing "reciprocal interdependence with others" and foregrounding "social harmony", "connectedness between conative, cognitive and affective aspects of cognitive acts" as well as the concrete, practical nature of knowledge (Van Vlaenderen, 1999, pp.172-3). These participants perceived problem solving as a predominantly inter-personal process where the construction of knowledge and discovery of *truth* were not absolute, objective and independent of those who define *it*.

However, with the experience of formal schooling primarily, the research participants in Van Vlaenderen's study are reported to simultaneously manifest newly emerging epistemic assumptions and concepts of problem solving which involved the acceptance of western socio-culturally derived and formal school concepts of individualism, the importance of argumentation and the formal method of problem solving disembedded from everyday life activities. Important in Van Vlaenderen's analysis is the observation that this emergent epistemic and problem solving approach was still at a transitional stage:

Congruent with the emerging belief in the individual capacity to develop expertise through formal training, the perception of problem solving as a social process moves to one of an individual intra-personal process. It changes from being perceived as a social encounter; that is context specific, to a mechanistic process of applying rules (Van Vlaenderen, 1999, p.174).

While this context embedded and socio-culturally shaped forms of thinking and problem solving elucidate on important aspects of cognitive development and functioning, it needs to be explicitly related to the regulatory processes through which they are shaped. That is, how do cultural processes and social relations regulate psychological development and functioning and why one and not the other of the different patterns of thinking are foregrounded in this development? Elucidating on such practices of culture and society and their potential to structure the developmental setting, Muthivhi (2008a) analysed the possible consequences of the two dyadic interactional modes Wertsch (1984; 1979) describes to determine a mode that closely resembled the formal processes of classroom teaching and learning.

According to Muthivhi's (2008a) interpretation, the first mode of interaction to produce the required performance in Wertsch's task involved a process that is consistent with formal learning and concept acquisition in school. That is, it involved formulation of mental models or imagining the task situation as well as planning and reflecting on possible consequences of action before it is executed, among others. For the children to produce a copy of the model object successfully, the mothers provided them with structured guidance which involved:

- Consulting the model to determine the identity and the location of the piece needed next.
- Selecting the piece identified above from the pieces pile, and
- Adding the piece selected in step two above to the copy object in accordance with its location in the model.

These strategic steps that characterised the mothers' actions in relating to the children and guiding them towards the mastery of the task involve cultural tools for thinking and learning and

are intended by adults to provide their children with a ‘mind-map’ for executing the task competently. Wertsch’s (1984; 1979) argues that this level of functioning characterised adult definition of the tasks and involved the zone of proximal development for children because they had not yet mastered them. The level of functioning of the children, at the start of the experimental task was at the “actual level of development” (Vygotsky, 1978) where they conceived of the task situation as involving:

- Selecting a piece from the pieces pile and
 - Adding the piece selected above to the copy object they were to produce
- (Wertsch, 1984, p. 81).

This latter mode of relating to the world and knowledge, or the children’s conception of task engagement, is informed by their spontaneous, everyday forms of learning. It limits children’s reflective capacities if endorsed by adults or formal schooling’s relational processes. This mode of task engagement emphasizes empirical and concrete activity rather than abstract, conceptual modes of thinking and task engagement. The method of task completion is based on trial and error mode that arise in spontaneous, everyday learning situations that emphasize the product or functional aspect of problem solving rather than its procedural, rule-following aspect. It is posited that both these modes of problem solving and task engagement constitute contradictory, though developmentally complementary processes that may play themselves out in complex ways at the level of individual psychological development and functioning.

What this discussion therefore suggest is that concrete modes of thinking and their associated practical approaches to problem solving, emphasizing the trial and error and perceptually driven approaches to task completion, are universal modes of everyday forms of practice and thinking

that precede the formal, school-specific and socio-historically determined forms that emphasize conceptual modes of thinking, manifested in the use of models, concepts and action planning and reflection. Using a specific approach to finding a solution to a problem or to address a task suggests adopting one or the other of the available modes of problem solving, informed by one or the other—or both forms of social practice in which one participates. To understand individual (ontogeny), it is therefore posited that we go beyond the individual to consider social and cultural processes that shape his or her thinking, without however reducing individual activity to that of its society and culture (Vygotsky, 1981; 1978; Piaget, 2001; 1966).

To examine this development and functioning of concepts and their application to problem solving situations, as a multidimensional process simultaneously involving both the internal individual mechanisms and the external, socio-cultural mechanisms, the paper presents an experimental study of school children's tasks performance. Replicating Macdonald's (1987) and Pieraut Le Bonniec's (1980) studies of the development and use of propositional reasoning, the present study examines the subjects' simultaneous use of the everyday concepts and the formal concepts to address the task problems regarding the understanding and use of the notions of possibility and necessity. The notions of possibility and necessity, in the Piagetian framework, comprise psychological categories or thought processes that are attained with the achievement of operational thought processes.

Piaget's framework posits that concrete operational thought (around 7-11 years of age) is characterized by the extension of the actual, concrete reality towards the direction of the potential or the possible. Classification of objects, for example, would be viewed as requiring a set of class inclusions. New objects can be included in a system of relationships with the objects that have

already been classified. Thus, further class inclusions become continually *possible* within a given system of classification. These reflective, reversible and operational activities are however only possible when linked to the subject's concrete activity or when the child can perceive the concrete nature of her mental actions—hence the term concrete operations (Piaget, 1964).

At about 11 years of age, children are viewed as having developed capacities for formal-operational thinking, technically referred to as the *hypothetico-deductive* reasoning. Hypothetico-deductive thought proceeds from what is possible to what is empirically real, with the deduction referring to the propositional states rather than to perceptions of concrete situations. As a result, instead of deriving the conclusion about what is possible directly from the empirical data and concrete states, the formal operational child begins with the postulation that certain relations are necessary (Piaget, 1966; 1964; Pieraut Le-Bonniec, 1980).

In her study, Pieraut Le- Bonniec (1980) found that children's ability to maintain uncertainty in relation to 'undecidable' situations, that is; situations that enable them to think in terms of what is possible rather than in terms of what is empirically real, emerges at about ten years of age. By this age, Pieraut Le-Bonniec's children were able to differentiate between instances where information for making a decision is lacking to cases where the information is complete to give judgement. That is, they were able to perceive and to distinguish between situations where something was "possibly the case" to where something was "necessarily the case".

Macdonald's study compared South African pupils across different cultural-linguistic schooling contexts. That is, it compared children learning in black township schools with a predominantly white, "multicultural" school that had begun to admit black pupils. The comparison extended

internationally to the results obtained earlier on in a similar study with the Scottish children (Macdonald, 1987). The study found that the black-township pupils consistently underperformed when compared with their South African “multicultural” counterparts as well as her Scottish and Pieraut Le-Bonniec’s French children in the respective studies. Conversely, pupils from the indigenous and culturally homogenous Sepedi speaking “township” school manifested an apparent developmental lag in their task performance, unable to consistently address all the task questions competently.

The Grade Five subjects (average age of 10 years) across the two South African school contexts, on the sample of 60 subjects from the multicultural school and 28 from the township school, were most telling in that the township subjects performed well below their multicultural counterparts, obtaining a score of 51% against 83% of the multicultural school sample. However, the question that arises from these results is: are the township Sepedi learners functioning at the same level of development as their superior performance multicultural counterparts? Put differently, does the quantitative aspect of the results provide enough evidence for inferring on the qualitative question regarding the achievement or non-achievement of a developmental level or stage? This paper proposes that the notions of lag or delay in the developmental acquisition of logical forms of reasoning, suggested within some Piagetian cross-cultural research, derived largely from a fundamental misinterpretation of the theory which if not corrected, could result in the misinterpretations of learners’ potential for learning and benefiting from educational processes.

As with Craig and Miller’s (1984) interpretation above, the results of the township learners can be interpreted in two alternative ways. First, it could be supposed that the poor performance was

due to the fact that the subjects have not fully acquired the formal operational thought processes. In this interpretation, the subjects' culture is viewed as contributing to the slower pace of developmental acquisition of the formal thought processes compared to their counterparts in the studies referred to above. The second alternative interpretation would be that the subjects have achieved the formal operational processes and understand the concepts at issue but that the functioning of these processes has been differently elaborated in line with dominant cultural practices of their schooling and the related socio-cultural traditions of learning and development. Both positions had been posited by Piaget (1966; 1972) as possible trajectories in the development of operational thought.

3. Methods

3.1. Research Design

The design of the present study is generally consistent with the Piagetian and the Vygotskian research frameworks. Piaget and Vygotsky generally used similar methodological design for investigating the development of knowledge. The experimental tasks sought to uncover the underlying mechanisms generating manifest thought processes. Both theorists used qualitative methods, comprising data collection techniques specifically suited for uncovering the causal dynamic processes underlying manifest cognitive functions and processes. Interviews with the subjects are termed, in the sense of Piaget (1981; 1968), the "clinical method". This is a method for interviewing which involves complex, probing questioning procedures. The interviewer poses the first question, which may be 'standard' across other, equivalent studies or relevant theoretical formulation. This question is normally followed up by subsequent, probing questions which are

formulated during the course of the interview; following on the subject's response and the interviewer's judgment of the extent to which the subject's response reveals his or her thinking about the task problem at hand. This method is particularly suited for a cross-cultural study where the experimenter is conversant with the language and the culturally-based relational forms of the participants.

This method is essentially meaning oriented and is specifically aimed at uncovering the depth of the underlying regularities of the subjects' thinking. It is a method also used by Vygotsky and Luria (Luria, 1979) in seeking to uncover the social and cultural influences on their subjects' thinking and problem solving processes. Crucially, the method requires the interviewer to understand the underlying theory that informs the experimental design and the theoretically derived categories of thinking that the experimental task seeks to uncover. For example, should the subject provides a response which reveals that he or she uses a mode of thinking that is not expected at the specific level or hypothesized developmental stage, a contrasting mode of thinking or possible response is proposed to determine if the subject would adopt it or insist on his or her initial response. Importantly, in this form of interviewing, the reasons the subjects provide to justify their responses are critical and provide the interviewer with key analytical tools for accessing the subject's thinking.

Thinking, from the perspective of both, Piagetian and Vygotskian theoretical frameworks, proceeds from pre-logical, through to context-bound, concrete logic to formal, hypothetical reasoning (Piaget, 2001; 1972; 1966; 1964; Vygotsky, 1981; 1978; Luria, 1979; 1976). The assessment of the development and functioning of these forms of thinking is carried out through the experimental tasks material which for Piaget, tends to be relatively free of cultural influences,

while for Vygotsky, may be adapted to the specific socio-cultural settings of their application to assess the relative mastery of the “cultural toolkit” (Cole, 1996). For both frameworks, the materials and procedures used in the experimental tasks must be easily understood by the subjects and should permit the subjects the opportunity for substantive engagement with the problems posed.

In line with these design principles, the present tasks make use of materials that are relatively free of cultural influences while simultaneously adapted to the language context of the subjects. The tasks, although could be easily adapted to any cultural context, equally provide subjects with the opportunity to make use their local, culturally specific knowledge to make sense of their materials and procedures For example, the interview was conducted in Tshivenda, which all the subjects speak and understands well. The tasks in the present study presuppose that the subjects would apply the formal notions of ‘possibility’ and ‘necessity’ which develop around ten and eleven years of age and are facilitated, from both Piaget(1981; 1966) and Vygotsky’s (1987; 1986; 1981;) perspectives, by the interpersonal relations of the subjects’ social and cultural processes and educational interventions.

3.2. Rationale

An investigation of the development and functioning of formal thought processes is crucial and particularly relevant for understanding the potential for learning and development of knowledge during schooling. South African schooling is, in particular, undergoing rapid transformation where the problems of learning that have built up into the system over more than half a century of apartheid neglect of schooling for the majority of learners have now taken centre stage. Better ways of understanding the role that cultural processes play in facilitating or impeding classroom

teaching and learning would benefit contemporary curriculum development initiatives and contribute to a better understanding of the methods for facilitating the acquisition and development of knowledge and concepts that are crucial for formal school learning success.

Past experimental research has suggested that the development and functioning of formal, operational thought processes among the South African children in the ‘townships’ and rural areas occur at a slower pace than that of their counterparts in urban, middle class and western cultural traditions of formal schooling. These studies have suggested that the African cultural traditions of learning and the specific traditions and vestiges of the apartheid schooling may be responsible for the developmental lag. However, the nature of these cultural factors, especially as they related to the specific learners’ schooling processes, has tended not to be sufficiently elaborated.

The present study will contribute to a clearer understanding of the problems regarding the cultural regularities of cognitive development and its relationship to the specific, socio-culturally shaped processes of formal school learning. The analysis of the subjects’ responses to the task questions will provide insights on their specific problem-solving approaches and strategies and the extent to which these strategies are adequate for successful learning in formal school settings.

3.3. Aim and hypothesis

The study aims to establish the modalities of the functioning of the operational thought processes among rural school children Based on the Piagetian idea that children at the operational stages of development have some intuition of ‘possible’ states of affairs and that they acquire the full

awareness and understanding of what is possible and what is necessary when they reach the formal operational stage, the study investigates the cultural content to which these processes are applied and elucidate on the nature of their manifestation during problem solving situations.

The study attempts to unravel the ‘content’ and ‘detail’ of the subjects’ ‘conceptualizations’ (Piaget, 1966, pp. 307-8; Dasen and Heron, 1981, pp.68-71) of the notions of *necessity* and *possibility*; which conceptualizations Piaget argues, may account for the divergent or culturally relative factors of development and learning (Dasen and Heron, 1981).

3.4. Participants/Subjects

A total number of eighty learners were interviewed for the tasks. Twenty learners were randomly selected from each of the four selected Grades in the junior primary and senior primary schools. The selection ensured all possible academic performance levels are included. Grade One and Grade Three subjects were selected from the junior primary school while Grade Five and Grade Seven subjects were selected from the senior primary school. While the schools had several classes per grade, only two classes from each grade were randomly chosen to participate in the study. Each class had between forty and fifty learners. The twenty learners from each class were selected from the class register. Every second learner of the top forty learners in the register list, or every second learner of the bottom forty learners in the register was invited to join the experimenter in the room where the interview was conducted, should a learner be present on the day of the interview and was willing to participate.

The child is first asked if she or he would like to participate or if he or she would not want to take

part in the “game”¹. The formal experimental session would begin only after the invited child has expressed an interest in participating in the “game”. Permission to work with the learners was obtained from the school, the local authorities and the learners’ parents through communications handled by the school management. Request for permission letter explained the nature of the study, the confidentiality of participants and the voluntary nature of participation. Where a learner or parent/guardian objected to the learner taking part, such learner would not be invited to participate in the game. Not a single objection from parents was received or reported while learners’ interest was confirmed by several of them approaching the experimenter requesting to be included in the list of participants.

The average age of learners in Grade One was six years old (6.5). Grade one was for the majority of pupils, their first encounter with formal learning. By Grade Three, learners were of the average age of eight years old (8.5). The junior primary school has four grades, that is, Grade One to Grade Four. The senior primary school pupils who participated in the study were selected from Grade Five and Grade Seven classes. The average age for Grade Five pupils was ten years old (10.5) while the average age for Grade Seven pupils was twelve years old (12.5).

3.5. Instruments/materials

The tasks made use of four circles of different colours, two red and the other two green, laminated with transparent plastic cover. The circles are made out of a hard cardboard box. Two

¹In the interviews with the pupils, the tasks were generally referred to as the “colour game”. The notion of “game” was aimed at making the task less formal and less school-like to the subjects, so that any possible failure to provide an answer is not likely to be interpreted in a negative light.

of these circles, one red and the other green, are each cut in the middle to make four half-circles so that there are two red halves and two green halves. The other two full circles; one red and the other green, are left uncut and are only used in the pre-test teaching or demonstration stage.

These experimental materials were adapted from Pieraut Le-Bonniec (1980) and Macdonald's (1987) experiments. The half circles can be placed together to form a red circle or a green circle. Two contrasting colour half circles can alternatively be placed together to form a circle with two contrasting colours, red and green. The other two full circles (one red and the other green) are used for demonstration purposes at the pre-test stage of the experiment, to show the subject what a red or green circle would look like. A silver tinfoil paper is used to cover a red or a green half-circle. The subjects will be required to hypothesise about the different colour values that could be made on the basis of this covered element, assuming that it is either red or green and that its definitive colour value is not knowable in advance. All the materials were familiar to the subjects and they comprised shapes with which they were already familiar in their school learning, in particular.

Further, the experimenter made certain that the subjects knew the names of the shapes and colours in their language and that they were aware that two half circles made a full circle and that a circle that could be made would be one or the other of the two colours presented to them. The materials therefore fulfilled two key criteria of cross-cultural experimental tasks, namely; that the tasks do not comprise unfamiliar materials and that subjects handle the materials and demonstrate familiarity with their properties. That is, subjects demonstrated that they understood and were familiar with the properties of the materials, namely; full circle, half circle, red colour, green colour and tinfoil cover.

3.6. Task procedures

Following the Piagetian tradition, the experiment comprised two stages, the pre-test, demonstration stage and the testing stage proper, which constitutes the actual experiment from which the data comprising the subjects' responses to the task questions is obtained. The demonstration stage is aimed at getting the subject familiarise herself or himself with the task materials and the experimenter to demonstrate the task procedures and ascertain that the subject understands the procedures and is familiar with the materials.

Demonstration stage: During the pre-test, demonstration stage the subject is first shown and encouraged to handle the materials while also naming them and saying what colour they are. The subject is first referred to the red full circle and the green full circle. Then he or she is referred to the half circles and encouraged to handle them and place them together appropriately to make the circles of different colours.

The last stage involved an explanation of the procedure that would involve the actual testing stage, namely; that if we cover one of the half circles and we are not certain which colour half has been covered, we can place it with the an uncovered half and still "guess" which colour full-circle we would have. Our "guess" will be based on the understanding that the covered half can only be red or green colour. The various colour situations that can arise from the experiment are demonstrated to the subject: If we cover a green half, we could make a red-and- green circle but the circle will be red if the covered half is red. It is impossible from this situation to have a circle that is green because the uncovered half is already red. After this explanation, the procedure is

repeated for the subject to say what possible colour circles would be made. After that the subject has demonstrated an understanding of the procedure did we proceed to the testing stage.

The experimental procedures could be carried out in any cultural context and therefore had no known cultural bias. The concepts evaluated are understood, from the theoretical point of view, as arising during spontaneous developmental process and therefore not limited to a specific cultural tradition whereas their elaboration may be a function of formal schooling, in which the subjects were already actively participating.

Testing: After the demonstration stage, the experimenter asks the subject to choose any one of the four half circles in the game and place it aside. After the subject has picked one of the four halves, the experimenter also picks up the other half circle of a different colour to the one that the subject has just picked up. The experimenter takes the two halves, one that he has picked up and the other that the subject has also picked up and explains to the subject that he is going to wrap them using a tinfoil paper as they did during the demonstration stage. The experimenter makes sure that the subject does not ascertain the actual colour value of either of the two halves as he covers them 'out of site'. The experimenter explains that he is covering these 'out of site' because we are not supposed to make out the actual colour of the halves are but to think of them as "either red or green" in colour. This procedure leads to what became the first situation, *situation 1*, of the experiment (See table 1). Situation One involved the experimenter asking the following questions in their order with the numbers in brackets representing the specific order in which the questions were presented.²

Table 1:

A question is either repeated or re-phrased where necessary, both at the request of the subject or at the discretion of the researcher, as a way of facilitating the subject's understanding and active participation. When situation 1 has been addressed, the subject is presented with situation 2 questions. Situation 2 involves the researcher placing into the game an additional, uncovered half circle of a contrasting colour to the red half already in the game. Situation 2 comprises three half circles; a red uncovered half, a green uncovered half and a tinfoil-covered half. The questions in table 2 were presented.

Table 2:

3.7. Recording of data

Data, in the form of the subjects' responses to the tasks questions was tape-recorded. The summary of the interview, in the form of the interview questions and the subjects' response patterns, was recorded in a notebook at the same time that the interview was taking place. The response that reveals the subject's understanding of the task question is recorded as a "competent" response while the response that manifests a lack of understanding is recorded as "not competent". The response is recorded as competent when it is judged to proceed from an "either-or" situation and appears to demonstrate the subject's awareness of the hypothetical state regarding the colour value of the covered element. Conversely, a response is recorded as not competent when it seems to ascribe a colour value to the covered element.

² See Muthivhi (2008a) and Muthivhi (2008b) for detailed presentation of the task procedures and questions.

3.8. Data analysis

The analysis examined the patterns of the subjects' responses in terms of whether these responses revealed the understanding of the notions of possibility and necessity. That is, a response that suggests that the subject does not ascribe a particular colour value to the covered element but formulates a hypothesis about the covered element and arrives at an indeterminate decision about possible colour situations is considered to have responded competently. On the contrary, a response that suggests that the subject ascribes a definite colour value to the covered element and thinks about the covered element in concrete terms, that is; in terms of "what is" rather than in terms of "what might be", is considered not competent.

The analytic emphasis is on the qualitative aspect of the subjects' task performance and aims to uncover the underlying modalities of concept functioning and development in the course of formal school learning. The Piagetian framework informs the analytic interpretations while the Vygotskian conceptual system is employed to examine the socio-cultural processes of the subjects' specific schooling to unravel and elaborate on the social and cultural regularities of the subjects' task engagement. The Vygotskian analytic approach, emphasizing the social and cultural activities in which individual development occurs complements the analytic approach in the Piagetian tradition which foregrounds self-regulatory processes to arrive at an adequate account of psychological development and functioning. This approach enables the examination of the meaningfulness of the subjects' actions as instantiations of their learning and development in their culture and schooling. Consequently, the analysis is theoretically informed and *genetic* in the sense both of Piaget (2001: 1981; 1970) and Vygotsky (1986; 1981; 1978).

4. Results

The Grade One subjects, unsurprisingly, experienced the most difficulties in responding competently to the tasks questions. These subjects obtained what was recorded as an overall competent response of only thirty six percent. The Grade One subjects performed worst on five task situations, namely; *situation 1c*, *situation 1f*, *situation 2f*, *situation 2g*, and *situation 2h*. In these task situations, jointly considered, the Grade One subjects were only able to provide two competent responses. The responses provided by these subjects, even on the situations that were recorded as competent, were in fact not using propositional or reversible criterion for thinking about the problem. That is, they did not in fact understand the possible state as compensatory and reversible. For example, situation 1c, although a possible state, was found to be more difficult because it was conceived as impossible. This decision was apparently based on the perception that once a one colour circle has been made from the preceding situations, which could obviously have been ascribed a definite colour value, a circle could not again have an alternative, two colours situation.

The form of thinking employed here seems to be something closer to what Vygotsky (1987; 1986) termed “pseudo concept”, and Bovet (1974 in Dasen and Heron, 1992) reported as “pseudo-conservation”. These subjects are, from the perspective of Piaget’s theory, at an early stage of the emergence of concrete operational thought and can therefore not be expected to produce fully competent performance on these tasks. It is around the age of eight, by Grade Three that we would expect the subjects to be established in the use of reversible thought processes, supported of course by the relevant concrete phenomena.

The Grade Three results, at 64% show a significant difference to the Grade One performance.

The difference between the Grade Three and the Grade Five results (68.9%), with a mean difference of 1.05³, is however not significant (see a full range of the subjects' performance across the four grades in table 3). These results suggest the location of these two groups together at concrete operations, although at the opposing ends of the stage. The Grade Five subjects would, from a quantitative perspective, be functioning at a level lower than that reported by Pieraut Le-Bonniec (1980) and Macdonald (1987) with regard to her middle class "multicultural" school. While these subjects, across all cross-cultural research contexts reveal universal developmental progression and the attainment of qualitative levels of structural organization, the Grade Five subjects in the present study were found to be quantitatively functioning at the level similar to that found in Macdonald's (1987) for the *Sepedi* speaking township learners.

Table 3:

For example, regarding situation 1b, forty percent of the Grade Three subjects argued that it is possible to make a circle that is green in colour, the majority of them arguing that the green uncovered half, outside the game, could be joined with the covered half to make a green circle if the covered half turns out to be green. Twenty five percent of the Grade Five subjects also responded to this question in largely the same fashion. This situation was in fact not possible to obtain from the given task situation because the uncovered half was already red in colour. These subjects generally applied concrete thought processes, interpreting 'the possible' in terms of 'the actual' and importing outside information into the task. They perceived of the possibility of the task situation in an empirical and functional manner, related to the utilitarian purposes of carrying out a task successfully and thereby failed to follow the rules of the "game".

³ See Muthivhi (2008a) and Muthivhi (2008b) for detailed statistical data presentation on these results.

The Grade Three and Grade Five subjects used their global understanding of what different colour circles could be made, as demonstrated to them during the pre-test, demonstration stage, and perceived the situation in terms of the “possibly-real”. As a result, they tended to exceed the bounds of the task demands and invoked the elements that were placed outside the game to solve the task problem. A similar mode of thinking was apparent in the subjects’ responses to situation 1f question. Subjects would, for example, respond to question 1f: “A few minute ago, another child made a one-coloured circle using the same halves as these in front of you. What colour do you think it was?” in concrete, functional terms. The subjects would, for example, either respond that they did not know what the other child did because they did not see the other child performing the task or guess what it is that the other child did. They would perceive the reference to “another child” to suggest a ‘real’ child among the learners’ in the school rather than a *hypothetical child* in the context of the experiment. The functionality of the responses here refers to the subjects’ perception of what the function of questions in their everyday context was and what goal the response is conventionally supposed to achieve. This function seems to differ from that characteristic of formal schooling where the cognitive, rule-based strategies rather than the social-relational and practical-functional strategies are emphasized.

In addition to this, in many of the task situations which were recorded as not competent, these subjects seemed to ascribe a definite colour value to the covered element, responding to the task questions from the perspective of what the situation “is”, instead of what “it could possibly be”. That is, their responses emphasized the concrete-functional mode of thinking, although there is no reason to think that these were not operational thought processes. The subjects seemed to understand *compensatory* conditions, or reversible processes, as they related this to some task

situations. However, the consistent application of the operational conceptual processes seemed to be constrained by the subjects' emphasis on the concrete and empirical form of knowledge.

The overall performances of the Grade Seven subjects underscored the fact that they had attained the formal operational stage and were able to use the formal concept of possibility competently to solve the task problems. These subjects scored an overall performance score of 85%, a score that suggests significant differences with the Grade Three subjects, whose developmental level constitutes the height of concrete operational thinking. However, as with the majority of their concrete operational younger siblings in the lower grades, and their transitional level ten year old, Grade Five subjects, the Grade Seven subjects were also prone to making perceptual errors that derived predominantly from their perception of the task problems as essentially concrete-functional and empirical. For example, the Grade Seven subjects tended to make errors in their responses to situation 1f and 1g.

Situation 1f proved to be the most difficult for these subjects. This may, as with the Grade Fives, be due to their perception of the hypothetical statement: "A few minutes ago another child made a one-coloured circle using the same halves as this in front of you...", as relating to a 'real' child and a 'real life' situation. As a result, most of these subjects argued that: "It depends on what colour halves the other child had used", or "I cannot say what colour it was because I did not see what the other child did". Still the subjects guessed what colour this was, on the same assumption that this was a real child who actually carried out these actions before their present turn.

In the case of task situation 2g, that required the formulation of a hypothesis about the covered element in relation to three possible situations, namely; a red and green circle, full red circle and

full green circle, most subjects who did not perform competently tended to miss the third situation. That is, they would provide a proposition about red and green circle and an all red circle, omitting an all green circle. This omission may have been due to the subjects lacking in the practice of simultaneously holding three categories constant in their minds as basis for problem solving and reasoning. While subjects may developmentally possess this capacity, practice in situations of thinking and problem solving may be necessary for successful performance in cognitively demanding situations, such as the experimental situation constitutes. This relation between internal capacity for thinking and the elaboration of such capacity through the necessary practice is at the core of the conceptual relationship between the Piagetian and the Vygotskian conception of the developmental acquisition of cognitive functions.

Situation 2h, for example, is expressed in long verbal statement which seeks to focus the subjects' attention on the relevant aspect of the task problem. Framing this question in a short and concise statement may equally result in lack of understanding when the essence of the question is not comprehensively captured by the utterance. This question has therefore tended to lead to perceptual error, probably due to the subject's lack of the ability to comprehend extended verbal instructions and to relate verbal instruction clearly to the relevant aspects of the task problem. In a socio-cultural setting where children rarely ask for clarification of adult instruction, such as during the present subjects' classroom learning situation as observed during the present study, the subjects are likely to reproduce this mode of functioning in the experimental situation and as a result respond to questions even when this was not accurately apprehended..

However, although the Grade Seven subjects were susceptible to making perceptual errors and use concrete mode of thinking in response to some questions, which could be explained through a

consideration of their socially and functionally oriented mode of problem engagement, their performance score suggests that they have mastered the formal thought processes. Their occasional lapses to concrete modes of thinking and problem solving may be normal from the Piagetian point of view, as the attainment of formal operational thought does not necessarily guarantee its consistent application (Piaget, 2001; 1970; 1966; Dasen and Heron, 1992). Meanwhile, Piaget's theoretical question was fundamentally not about the quantitative nature of development *per se*, but about the qualitative progression to higher developmental levels (Piaget, 1966; Dasen and Heron, 1992) involving qualitative rather than quantitative structural transformations.

5. Discussion

The notion of developmental lag, cultural deficiency or disadvantage pertaining to the developmental performance of subjects from diverse socio-cultural backgrounds in South Africa has largely been premised on quantitative considerations. Such considerations usually overlook or undermine the common, universal essence of human thought processes that are the hallmark of Piaget's theory. Piaget approached the question of development as an epistemic rather than a simple empirical question to be addressed through simple application of empirical tests. The experimental tasks in the present study confirm the subjects' qualitative achievement of the operational forms of thinking at the same age levels across the different cultural context of schooling represented by the different studies described in the present paper. The cross-cultural differences, from the analysis of the subjects' task performance above, seem to point at the significance of the cultural content to which these developmental achievements are applied as a critical factor determining the specific mode in which cognitive structures are elaborated.

The Grade One subjects, although theoretically at an early stage of concrete operational thinking, can nonetheless not be expected to perform competently on the task if their school learning activities do not emphasize a cognitive orientation to problem solving but a more socially oriented and functional approach. It was therefore not surprising that the problem solving strategies the Grade One subjects employed did not reveal any pattern suggestive of conceptual thinking. Instead, their performance seem to be akin to what Vygotsky argued was pseudoconceptual form of thinking (Vygotsky, 1987; 1986), where functions could, on surface appearance, reveal a conceptual form while it in fact has not conceptual basis at all.

While the Grade Three and the Grade Five subjects had already attained the concrete operational logic, with the Grade Five at the beginning of formal operations, their emphasis on the functional and practical problem-solving orientation seems to manifest the dominant forms of learning in which they participate during their schooling. Vygotskian research (Luria, 1979; 1976; Hedegaard, 2002; 1996; 1990) illuminates on the nature of the social relations that regulate thinking and concept development. Luria's famous research in central Asia found that subjects employing everyday forms of knowledge and reasoning tended to emphasize how objects function in their everyday life situations. Hedegaard (2002; 1996) and Arievidich and Stetsenko (2000) report on two distinct epistemological approaches to classroom teaching (and learning) that generate different forms of learning and development; one based on everyday, spontaneous modes while the other based on abstract, theoretical modes that emphasize explicit, rule-based conceptual forms that generate the associated cognitively oriented problem solving strategies.

Forms of classroom interaction that emphasized the empirical and functional modes of teaching and learning were observed in the present subjects' schooling (see Muthivhi, 2008a; 2008b).

Teaching and learning in this context emphasized the learners' immediate experience and concrete, observable phenomena. Learners were rarely engaged on tasks that had clear instructions on the basis of which they could explore and examine the task and generate new understanding from this activity. Classroom relations emphasized the social aspect of learning where learners were expected to acquire adult forms of knowledge rather than learning how to master cognitively-based, problem solving strategies related to the acquisition of formal, scientific knowledge of the subject matter. The social function therefore superseded the individual, self-regulatory possibilities of knowledge and learning.

Vygotskian studies emphasize the importance of socially and culturally mediated form of knowledge as cultural-psychological tools, once they have been internalized into the subjects' own knowledge and problem solving strategies. This social 'structuration' (Brayant (1997) of learning and development could be understood in the sense in which Wertsch (1984) described dyadic interactions between mothers and children. In this description, the strategic steps for task engagement, offered at the subject's zone of proximal development, may characterize a socially structured, systematic approach to problem solving characteristic of the formal processes of classroom teaching and learning.

On the contrary, the strategic steps at the subjects' 'actual level of development' or what lies in the subjects' natural capacities within their spontaneous, everyday learning activities characterizes knowledge forms learners bring into formal school learning, which needs to be transformed through the formal learning activities. When formal learning fails to fully transform this everyday, spontaneous knowledge and learning modes, school learning and development may manifest transitional knowledge forms characterized by the coexistence and co-functioning of the

contradictory psychological processes, as instantiated by the task performance modes of the present subjects. This is a form of functioning is also similar to that reported by Van Vlaenderen (1999) as a transitional stage characterising her subjects' emergent epistemic and problem solving approach, after that they had participated in a formal training programme, equivalent to the formal programme of school learning activities.

The notion of possibility may therefore be understood as constitutive of two distinct psychological processes involving the spontaneously occurring, everyday epistemic functioning on the one hand and the conceptually-based modes of functioning elaborated through active participation and meaningful engagement in formal school learning, provided of course that the practices of schooling are appropriately organized to generate such knowledge forms. The spontaneous mode of the functioning of this concept would be related to the perceptual and concrete activities of learning and development while its formal mode may be related to the systematic and conceptual structuration of knowledge characteristic of formal schooling.

Therefore, at the level of the everyday, spontaneous learning and development, the notion of what is 'possible' would be closely related to 'the real', 'what *can* be done'. This notion is qualitatively different from the notion of 'the possible' as involving thinking that proceeds from mental abstractions and not embedded on specific practical contexts of its application. The later constitutes the formal aspect of the concept characteristic of the modes of school learning, involving abstract and problem-based cognitive activity. This activity comprises an awareness and deliberate use of mental rather than concrete categories to perceive possible and necessary states and is (or should be) characteristic of the modes that formal school learning should inculcate on the part of learners. Where formal schooling has not been successful to bring about the transformation of thought and the conscious and deliberate use of the formal processes of thinking, cognitive development may manifest the form of heterogeneity of functions that

characterized subjects' task performance in the present study. This manifest form of functioning does not however suggest a lack of the underlying capacities whose emergence is determined by the natural developmental processes.

6. **Conclusion**

The present paper, using the results of the experimental task performance and interpreting this performance using Piaget and Vygotsky's theories complementarily, examined the idea that the level of performance on Piagetian tasks by subjects from non-western, socio-culturally diverse contexts of learning and development may be suggestive of a slower rate of cognitive development on their part. These subjects' apparently poorer performance levels on cross-cultural tasks, compared to their westernized counterparts, have given rise to the use of the concept of cognitive and cultural lag, as definitive of their mode of development.

The subjects in the present study revealed a mode of performance consistent with that found in the comparative studies. However, the interpretation of these performance results reveals that the concept of lag is not a sustainable one as the suggestion for such a concept was based on quantitative considerations of performance scores, an approach that is—it was argued, contradictory of the original question in Piaget's theory. The question of a developmental achievement of progressively higher levels of functioning, according to Piaget, is a qualitative one. That is, a determination of achievement of these qualities of thought is based on experimenter's knowledge of the mode of the subjects' successful performance on Piagetian task and not on the quantity of performance scores attained.

Therefore, an analysis integrating Vygotsky's theoretical contribution examines the ways in which

the subjects' task performance may have been shaped by their socio-cultural context of learning and development. This further permits a transcendence of a focus on the internal activity of the subject in isolation of the activity of his or her culture and society, which contribute to the structuration of the subject's internal cognitive functioning. Viewed in this way, the subject who applies the two contrasting modes of functioning inconsistently to solve the task problem is not assumed as manifesting a cognitive lag. On the contrary, the heterogeneity of psychological functioning is considered a dynamic product of the subject's cultural context of development. Specifically for these subjects, the socio-cultural processes of their schooling and classroom teaching and learning seem to manifest specific modes of knowledge and forms of relations that should produce particular forms of culturally elaborated concepts and modes of thinking, similar to their performance in the present experimental tasks.

Reference List

- Arievich, I. M. & Stetsenko, A. (2000). The quality of cultural tools and cognitive development: Galperin's perspective and its implications. *Human Development*, 43, 69-92.
- Bryant, P. (1997). Piaget, mathematics and Vygotsky. In Smith, L; Dockrell, J. and Tomlinson, P. (Eds.). *Piaget, Vygotsky and beyond: Future issues for developmental psychology and education*. New York: Routledge. 131-144.
- Buck-Morss, S, (1975). Socio-economic bias in Piaget's theory and its implications for

- cross-cultural studies. In Riegel, K.F. (Ed.) *The Development of Dialectical Operations*.
Basel: S-Karger.
- Cole, M. (1996). *Cultural Psychology: A Once and Future Discipline*. Cambridge, MA:
Harvard University Press.
- Craig, A. (1989a). New students in old universities: Cognitive development in the South
African tertiary education context. *South African Journal of Higher Education*. 3, (1):
153-158.
- Craig, A. (1989b). The conflict between the familiar and the unfamiliar. *South African
Journal of Higher Education*, Vol. 3 (1), 167-172.
- Craig, A. (1987). A cognitive infrastructure for change in Southern Africa. *Theoria: A
Journal of Studies in the Arts, Humanities and Social Sciences*. 70. 77-84.
- Craig, A. (1985). Mothers and Children: An Analysis of Change. Unpublished PhD
thesis. University of Natal, Durban.
- Craig, A. & Miller, R. (1984). Mother-Child Interaction. In, Edwards S.D. (Ed.),
Development and Enrichment Strategies for Disadvantaged Children. Kwadlangezwa:
University of Zululand.
- Cubero, M. & de la Mata, M. (2008). Activity Settings, Discourse Modes and Ways of
Understanding: On the Heterogeneity of Verbal Thinking. *Culture and Psychology*. 14
(4), 403-430.
- Dasen, P. R. & Heron, A. (1992) Cross-cultural tests of Piaget's theory. In Smith, L.
(Ed.) *Jean Piaget: Critical Assessment*, London: Routledge.
- Department of Education (n.d.). *National Curriculum Statement General Education and Training
Assessment Guidelines for Natural Sciences (Intermediate and Senior Phases)*. Pretoria:
National Department of Education, South Africa.

- Hedegaard, M. (2002). *Learning and Child Development: A Cultural-Historical Study*. Aarhus. Aarhus University Press.
- Hedegaard, M. (1996). The zone of proximal development as basis for instruction. In, H. Daniels (Ed.), *An Introduction to Vygotsky*. London: Routledge.
- Hedegaard, M. (1990). How instruction influences children's concepts of evolution. *Mind, Culture and Activity* 3: 11-24.
- Kamin, L.J. (2006). African IQ and mental retardation. *South African Journal of Psychology*, 36(1), 1-9.
- Kok, A. (1986). The Zone of Proximal Development from another perspective. *Unpublished Masters dissertation*, University of Natal, Durban.
- Le Bonniec, P.G. (1980). *The Development of Modal Reasoning: Genesis of Necessity and Possibility Notions*. New York. Academic Press.
- Levert, T., & Jansen, P. (2001). A Lurian-Piagetian approach to assessment of historically disadvantaged black scholars in English medium schools. *South African Journal of Psychology*, 31(4), 21- 31.
- Luria, A.R. (1976). *Cognitive Development: Its Cultural and Social Foundations*. Cambridge, Mass.: Harvard University Press.
- Luria, A.R. (1979). *The Making of Mind*. Cambridge, Mass.: Harvard University Press.
- Macdonald, C. A. (1987). *Le Bonniec's Epistemic Modality: Cross Cultural Replications*. Pretoria. Human Sciences Research Council.
- Matusov, E. (2008). Applying a sociocultural approach to Vygotskian academia: Our tsar is not like yours, and yours isn't like ours. *Culture and Psychology*. 14 (1), 5-35.
- Miller, R. (1985). Cognitive development and social change: Theoretical issues. In, Lagunes, I.R. & Poortinga, I. (Eds.), *From a Different Perspective: Studies of Behaviour*

Across Cultures. Lisse: Swets & Zeitlinger.

Miller, R. (1984). Reflections on mind and culture. *Inaugural Lecture*. Pietermaritzburg:

University of Natal Press.

Miller, R. (1979). Is there room for Piaget and the teacher in the classroom? Jerusalem:

Hadassah-wizo.

Moll, I. (1995). Cultural people and cultural contexts: Comments on Cole (1995) and

Wertsch (1995). *Culture and Psychology*, 1 (3), 361-371.

Moll, I. (1994a). School was far away: The formal perceptions, classifications and

sylogistic reasoning of Kokwane Ndlovu. *Perspectives in Education*, 15 (2), 189-217.

Moll, I. (1994b). 'Reclaiming the natural line in Vygotsky's theory of cognitive

Development'. *Human Development*. 37. 333-342.

Moll, I.C. (2004). Internalisation in Piaget and Vygotsky: The Question of the Synthesis

of the Two Theoretical Traditions and its Implications for the Analysis of School

Learning. *Unpublished doctoral thesis presented at the Faculte de Psychologie et des*

Sciences de L'Education: University of Geneva, Geneva.

Moll, I. & Slonimsky, L. (1989). Towards an understanding of cognition and learning

in the academic support context. *South African Journal of Higher Education*, 3 (1), 160-

165.

Muthivhi, A.E. (2009). A Dialogue between Piaget and Vygotsky on the

Developmental Acquisition of the Notions of Necessity and Possibility: A South African

Case Study. . *Journal of Educational Studies*. 8 (1), 68-90.

Muthivhi, A.E. (2008a). *A socio-cultural case study of the schooling system in*

Venda, South Africa. Unpublished doctoral dissertation, University of the Witwatersrand,

Johannesburg–Johannesburg.

- Muthivhi, A (2008b). Language policy, classroom practice and concept learning in a Grade One Tshivenda classroom. *Southern African Review of Education*. 14 (3, 23-35 .
- Muthivhi, A.E. & Broom, Y. (2008). Continuities across schooling transition: A case of classroom practices among teachers in Venda, South Africa. *Journal of Educational Studies*. 7 (1), 87-104.
- Perret-Clermont, A. (1997). Revisiting young Piaget in Neuchatel among his partners in learning. In Smith, L; Dockrell, J. and Tomlinson, P. (Eds.). *Piaget, Vygotsky and beyond: Future issues for developmental psychology and education*. New York: Routledge. 91-120.
- Piaget, J. (2001). The stages of intellectual development of the child. In Gauvain, M. & Cole, M. (Eds). *Readings on the Development of Children*. New York; W.H. Freeman & Co.
- Piaget, J. (1981) The theory of stages in cognitive development. In Gallager, J.M. and Reid, D.K. (Eds.). *The Learning Theory of Piaget and Inhelder*. Monterey: Books-Cole.
- Piaget, J. (1970). *Genetic Epistemology*. New York: Columbia University Press.
- Piaget, J. (1968). *Six Psychological Studies*. London: Harvester.
- Piaget, J. (1966). Needs and significance of cross-cultural studies in genetic psychology. *International Journal of Psychology*, 1 (1), 3-13.
- Piaget, J. (1964). 'Development and Learning'. In Ripple, R. and Rockcastle, V. (Eds.). *Piaget Rediscovered*. Ithaca: Cornell University.
- Shayer, S. (1997). Piaget and Vygotsky: A necessary marriage for effective

- educational intervention. In Smith, L; Dockrell, J. and Tomlinson, P. (Eds.). *Piaget, Vygotsky and beyond: Future issues for developmental psychology and education*. New York: Routledge. 36-59.
- Stetsenko, A. (2008). From relational ontology to transformative activist stance on development and learning: Expanding Vygotsky's (CHAT) project. *Cultural Studies of Science Education*, 3, 465-485.
- Tulviste, P. (1991). *The Cultural-Historical Development of Verbal Thinking*. New York: Nova Science Publishers.
- Van Vlaenderen, H. (1999). Problem solving: a process of reaching common understanding and consensus. *South African Journal of Psychology*, 29(4), 166-177.
- Vygotsky, L.S.(1987).*The Collected Works of L.S Vygotsky. Volume I: Problems of General Psychology*, New York: Plenum Press.
- Vygotsky, L. S. (1986).*Thought and Language*. Cambridge, Mass.: M.I.T.Press
- Vygotsky, L.S. (1981). The genesis of higher mental functions. In Wertsch, J.V. (Ed.). *The Concept of Activity in Soviet Psychology*. New York: Sharpe.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge: Mass.: Harvard University Press.
- Wertsch, J. V. (1985a.). *Vygotsky and the Social Formation of Mind*. Mass.:Harvard University Press.
- Wertsch, J.V. (1984). The zone of proximal development: Some conceptual issues. In B. Rogoff & J.V. Wertsch (Eds.), *Children's Learning in the Zone of Proximal Development*. San Francisco: Josey Bass.
- Wertsch, J.V. (1981). *The Concept of Activity in Soviet Psychology*. Armonk, N.Y.: Sharpe.

Wertsch, J.V. & Tulviste, P. (1992). L.S. Vygotsky and contemporary developmental psychology. *Developmental Psychology*, 28 (4). 548-557.

Table 1: Situation 1 questions based on the tinfoil covered half circle and the red, uncovered half circle.

- (1a). If we remove the foil, will it be possible to make an all-red circle?
- (1b). If we remove the foil, will it be possible to make an all-green circle?
- (1b). If we remove the foil, will it be possible to make a one colour circle?
- (1c). If we remove the foil, can the full-circle be red-and-green in colour?
- (1d). If we remove the foil, will the circle be of one, or two, colours?
- (1e). If the circle that is made out of these two halves is one colour only, what colour does it have to be?
- (1f). A few minutes ago, another child made a one-coloured circle using the same halves as these in front of you. What colour do you think it was?
- (1g). What colour can all the circles that can be made out of these halves be?

Table 2: Situation 2 comprising three half circles; a red uncovered half, a green uncovered half and a tinfoil-covered half.

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- (2a). Can we make a red-and-green colour circle?
- (2b). Is there another way in which a red-and-green circle can be made from the half circles in front of you?
- (2c). With these half circles, will it be possible to make an all-red circle?
- (2d). If the tinfoil is removed, will it be possible to make an all-green circle?
- (2e). If the foil is removed, can we make a one-coloured circle from these halves in front of you?
- (2f). If we want to make a one-colour circle, by these halves in front of you, what colour will it be?
- (2g). If the foil is removed, what are the different-colour circles that can be made from the half circles in front of you?
- (2h). If the one colour circle that is made from these halves in front of you has to be one colour only, that is: all-red, or all-green, it has to take the colour of one of these three halves. Can you say which one this half circle is and why do you think so?

Table 3: Overall total numbers of competent responses to both *situation 1* and *situation 2* questions by subjects from across the four Grades

| Grades | Grade 1 | Grade 3 | Grade 5 | Grade 7 |
|---|---------|---------|---------|---------|
| Responses in % out of a total of 280 responses per Grade. | 36% | 64% | 68.9% | 84.6% |