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Chapter 2 Research method, philosophical affinities and dynamic assessment within intelligence

2.1 Introduction

This chapter presents a brief overview of what is considered to be vitally important issues when discussing theories and models within dynamic assessment and intelligence. The meta-theoretical framework developed by Madsen (1988) is the framework employed in this thesis. A major area of concern within his overarching scheme is the amount of attention paid to basic, fundamental philosophical positionings with which theorists align themselves. This framework will be discussed at length in chapter 3 but it is necessary at this point to align this study with the concerns voiced by Madsen and Jordaan (1989) and that is to strive for explicit formulations of implicit assumptions pervading theories and models or even points of view. Although the author is not developing a theory but rather assessing other theories it is nevertheless deemed important that implicit assumptions are rendered manifest at the outset of any study.[1]

2.2 Literature - prime source of information

For the sake of clarity the reader is briefly engaged in the process undertaken to elicit sources from online databases. The following macro-search encompasses platforms, publishers and individual on-line journals (the list of individual journals is not stated herein, due to the fact that a substantial number of these journals are already indexed by the platforms mentioned below). Only a few individual journals are searched; these being journals that are only available on-line and hence not necessarily indexed by traditional platforms.

The search terms combine the need to include the status of theory within psychology and dynamic assessment research, which itself is subsumed within the field of intelligence research. Overlaps in the content of the number of “hits” were expected but due to the nature of the indexing criteria as specified by different vendors, this frequency is not at all high. Thus, the search is divided into the above-mentioned categories and included keywords/phrases captured within the "title" and "keywords"; as well as being listed in the "title, abstract and keywords" as these formed part of the refined searches as they now included a greater scope of research. Platforms searched follow below:

2.2.1 Platforms searched[2]

- Bookfind which includes Premier Service as well as Bookwise; Cambridge scientific abstracts; Current contents at Ovid; EBSCO Host which includes Academic Search Premier and Master File Premier (2000+); ECER (1969 - 2002/12); ISI web of knowledge which includes Science Citations Index, Social Science Citation Index and Arts and Humanities Index (2000+); ERIC (1966 - 2002/12); Emerald; HighWire press; Ingenta; Ingenta Select; InfoTrac - expanded academic ASAP; Kluwer Online; Philosopher's Index; Oxford Journals; ProQuest; Psyche; Psycholoquy; PsycINFO (1887+); Sage; Science direct; Springer Link; SwetsWise; Wiley Interscience and Wilson's humanities abstracts

Three local South African databases were scoured for information and research into the topic, namely the Nexus[3] National Research Foundation (NRF) database, the Human Sciences Research Council (HSRC) database as well as SABINET; the local South African database indexing and amalgamating higher education and academic institutions publications.

2.2.2 Questionnaire

Most of the information contained within this research was gleaned from published sources as well as from interviews conducted with practitioners in the field. Questionnaires were delivered to one hundred dynamic assessment practitioners across the globe. More information concerning this exercise can be found in Appendix 2 which delineates the entire process from questionnaire

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[1] Although not yet discussed, the author is, by commencing this chapter, attending to what Madsen refers to as the meta-stratum of concern. The issues pertinent to this meta-stratum are considered paramount to the scientific endeavour of model and theory development, especially within the social sciences which do not possess the luxury of more constrained systems as found in the natural world (before a retort is offered to this statement, the author wishes to remind the reader that the study of human behaviour will most likely prove the most perplexing of all complex systems seeing as we are a part of the system we wish to study; an inherent and inescapable limit within the system thus resulting in a system which cannot *ipso facto* be studied). Not to mention the fact that unlike physical systems which are more often than not uniform in nature, human behavioural systems are not (Feist, 1995).

[2] Of particular note within these databases are PsycINFO, ERIC, ECER , EBSCO host and ISI web of knowledge which are the main sources for the topic at hand.

[3] Not the most reliable database and certainly not up to date.

conceptualisation through to end results. However, due to the very low response rate, it was deemed more appropriate for this study to append the exercise rather than have it as a focus and topical point within the body of this thesis.

2.3 Model utilised

This theoretical study seeks to advance dynamic assessment theory within intelligence research and in order to explore a meta-theoretical framework which will suit such an endeavour, analyses of existing theories, models and mini-frameworks will be studied with the aid of a model of comparative criteria as originally set out by K.B. Madsen of which more will follow below.

2.3.1 The pervading meta-theoretical framework

Of the few models (Royce, 1975) that expand on the meta-theoretical advances within psychology far fewer are evident for psychology's sub-discipline of intelligence assessment and none are evident within the further submerged field of dynamic assessment.[4] A comparative overview encompassing various strata of influential forces will serve as model according to which assessments of theories, models and schemas will be studied and conclusions deduced from such comparisons. Although references other than those of Madsen are consulted and fused into his models, Madsen's understanding of the broader field upon which the theories and models are constructed and subsequently play out was deemed more in keeping with the meta-theoretical notions and research predispositions of the author. In Chapter 3 Madsen's views on models, theories, meta-theories and overarching philosophy of science will be looked at in-depth; yet there is a two-fold reason as to the necessity of warranting this chapter. Firstly, the author's implicit assumptions regarding certain key philosophical issues play out within the broader scope of dynamic assessment within intelligence and secondly, these views are subsumed within Madsen's framework of meta-theoretical psychology.

The "fit" then, between methodology and scheme and likewise between Madsen and author should not be underestimated as the author too has leanings, philosophical preferences and ideas of her own which will ineluctably colour the process of investigation and conclusions reached at the finale. That this remark should so early on make its presence is rather telling of how strong a consideration it is that prior beliefs, notions and ideas pervade any work within the realm of science. Without opening the floodgates to a heated debate between the empirical-realist vs. relativist stance on how science is practiced, let it be known at the outset the various philosophical positions of this author.

2.4 Laying personal cards on the table: a deck of truth

In order to contextualise and frame the study within a time and place a brief excursion into the author's philosophical leanings is warranted as these leanings impinge on the study consciously and seep in throughout unconsciously.

2.4.1 Geographic and socio-political location

The author was born and has always lived in Pretoria, South Africa. A climate of tolerance and democracy followed a long period of repression and malcontent. A history replete with misunderstandings, intolerance and chaos ended after considerable struggle within totalitarian regimented governance. Although anchored to the past, the emerging socio-culturally multilayered society within which the author works has undoubtedly influenced most life experiences and in areas none more so evident than within intelligence assessment. The confluence of Western ideals has at times met equally with resistance, appreciation and integration in ways which are at times more difficult for westerners of other industrialised nations to understand and with which to get to grips.

2.4.2 Time

All times are unique and interesting. To say otherwise would indicate a time and place in which nothing much happens in the way of progress or lack thereof in any area. The most that can be said of this period in human history is that we simply have a larger repository of historical facts on and from which to lean and gather information. Much of it is obsolete (phlogiston, ether, Freudian psychoanalysis[5]) (Skinner, 1986) and much is unnervingly prescient to occurrences at present[6] (how not go about assessing for a reified construct such as intelligence). This work may well be relegated to the bin of obscurity in the year 2205 entitled along with other works as "research of the time" or work in keeping with the known facts at the time. How to "understand" outside one's own time is indeed a rare gift or luck as the case may be. Suffice it to say that apologies about what has not yet

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[4] As far as the author is aware at the time of writing this thesis, 2005. What may come to light of day or what might have been missed reflects one or both of two conditions: lack of thorough searching and constraints due to time. The former contributing more weight as erroneous research (controllable error) than the latter.

[5] Interestingly enough though, Freud did attempt to redress his psychoanalytical thoughts and attune it towards a more natural science approach (a neurological reductionist one) (Wilson, 1996).

[6] To add cliché to sentiment recall Santayana's saying about those being doomed to repeat history! (Cole & Valsiner, 2005).

occurred will not do. Strides in neuroscience, theory development, measurement techniques, quantum computation and behaviour in all its flavours will impinge on what is written now and although speculation as to what waits for us in years to come might stimulate and provoke controversy, the author wishes to leave such ponderings to philosophically inclined science-fiction writers.[7] The great equaliser after all is time and as such it will tell.

2.4.3 Schooling within psychology

Beginning with Wundt's laboratory in Leipzig in 1879 and following a trajectory all too familiar within Western psychological academia, the author has been exposed to a host of eminent key players, rather too heavily focusing upon American mainstream psychology perhaps.[8] That the role of such mainstream psychology should ever be underestimated would be a misfortune indeed but in order not be blind sighted by such powerful testimony to such an edifice, a tolerant and incisive look at what emanates from across the globe might well yield fruits which if not tasted will start to rot. The roots of dynamic assessment are not always commensurate with the hitherto received notions of what it means to conduct assessments but as was hinted above, time will tell whether other psychologies will repatriate with their own territories or make their winding way into a confluence of mainstream Western psychology. Our global emancipated future (if the present is anything to go on) will surely be the result of less divergence in many areas of life. But who is to know. The fact that in 2005 dynamic assessment may either be confined to anecdotal footnotes within future psychological assessment texts or finds a voice large enough to engulf other smaller theories (or models) is testament to the precipice it now faces. The author's literary wonderings as far a field as Russia, Israel and the United States and as locally diverse within South Africa has lead to the discovery of well written documentation abounding in areas within psychology over-and-above that with which undergraduate students are confronted in South Africa.

2.4.4 Personal experiences within psychological intelligence assessment

Confronted with intelligence tests that necessitate speedy and accurate responses, in a climate of anticipation and stress and being cognisant of a future which depends on these very answers on which one is about to deliberate (not to mention the consternation at being placed below your fellow peers who aim to outdo everyone else on the pretext of being socially very accommodating) is a snapshot of what a testing situation may be like for some. To have this experience repeated for the next eight or so years and then to have finally "made it" into an area of work in which eventual comfort is found is rather more telling of our cultural understanding of what intelligence is than what it in fact truly is. Not that one is yet protected within the confines of working life, as you are threatened from all corners regarding performance goals and assessments that will "help" you focus that little bit more. Once you have managed to secure a worthy fulfilling role within your working life, you are routinely assessed in many other areas of life. Old age assessments have now become a lucrative source of mutual beneficence (or so it seems) in which as a wiser yet "slower" individual you are now bombarded with yet more tests of well-being and global functioning assessments.[9] From cradle to grave (Suen, 1990)[10] one is confronted with tests of all sorts. Do they really make a difference and how? That they do is not in question, how they do so, however, is.

2.4.5 Philosophical leanings – implicit assumptions pervading this study

As things in life rarely remain the same (if even genes randomly mutate what chance do you really have?) so too does this sentiment apply to one's philosophical leanings and much the same as that well worn pendulum-analogy illustrates, a slow but progressive tick-tock is all that represents growth and development within any area but specifically within matters philosophical. To unequivocally state that one is such-and-such a person or that one has this-or-that leaning towards these-or-those issues is tantamount to stretching the truth somewhat as nothing is really set in stone. However, to perhaps venture a general leaning towards such-and-such a view is not altogether unfounded. That certain creatures do not change their stripes nor spots should nest this particular notion. Doing away with metaphors for the moment, it is necessary that philosophical positions or a so-called "philosophy of man" (Madsen, 1971) be delineated at the outset of a study dealing specifically with other researchers' leanings. Not to do so would seem hypocritical. There are many frameworks from which to choose and most offer similar axes and co-ordinates as to where one should comfortably place oneself. On three dimensions then, this matter will rest.

2.4.5.1First axis – A Jungian typology

Nicely entrenched within this typology of types is the concise generality of its notion. Although generality can be construed as either a hindrance or a progressive stance on the matter of personality classification, the author feels at home in using this as

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[7] With whom I share affinities.
[8] A common trend across the globe (Slife & Williams, 1997) which is not a criticism just an observation. However, as time moves forward, there is an increasing awareness of non-Western influences in psychology cf. Pillimer and White (2005) in this regard who focus on developmental psychology within the larger domain of science.
[9] Our ever-increasing older population (mainly within industrialised nations) (Cohen, 2005) is proving to be "quite the sample" to study, what with all the benefits emanating from this potentially rich source of income.
[10] Literally.

generally descriptive of her stance pervading this entire treatise. On the attitudinal type – introversion; on the psychological function – thought is paramount, followed by intuition, sensation and followed lastly by feeling; in totality the personality type which best describes the author is introvert with thinking and intuition (ITN). This rendition of events is simply the assessment made by the author in a very informal manner.[11]

2.4.5.2 Second axis – A more traditional axis: an informal personal psycho-epistemological profile [12]

The more classical epistemological categories include such philosophical affiliations as realism, idealism, empiricism, rationalism and intuitionism (Royce, 1964, 1970a, 1973; Royce, Coward, Egan, Kessel & Mos, 1978[13]). On a rather mundane linear hierarchical scale, the author acknowledges her leanings in the following manner:

1. Rationalistic
2. Intuitive (metaphorism)[14]
3. Empirical
4. Realistic
5. Idealistic
6. Authoritarian

Cognisance is taken of the fact that although the author has positioned herself as an introvert in the Jungian typology this might seem contradictory to her subsequent positioning on the intuitive scale as evidenced above, as this is often regarded as a mark of extraversion (Eysenck in Madsen, 1987). This can be justified by stating that socially introversion is more evident yet within professional research the latter (extraversion) is more evident.

2.4.5.3 Third axis – A complement

Numerous dichotomies[15] (legitimate or otherwise; Cole & Valsiner, 2005) pervade philosophical and psychological constructs, however the following seven contentious issues were decided upon as they play a large role in how the products of intelligence and assessment research endeavours flavour resultant conclusions. In particular for the purposes of this study and for this author, that these implicit assumptions guide any investigation is testament to their historical contingency and morally situated nature (Kristensen, Slife & Yanchar, 2000; Slife & Williams, 1997). The fact that some of these issues are not always suitably dealt with in the intelligence and dynamic assessment literature is telling of two possibilities: either that some of these to-be-mentioned issues are not considered problematic within the respective fields of study or that such issues are not instrumental in any purported advances to be made within these respective fields. That these issues are usually missing (or consciously avoided) further entices the author to state her proclivities in this regard as they are considered essential. The development of science in general, the social sciences and psychology in particular regarding theories and models is a primary concern for philosophers of science who seek to understand various conceptions of understanding, in other words such philosophers are concerned with epistemological and ontological issues which lead to different choices regarding various aspects including choice of assessment in this particular instance (Schraw & Olafson, 2003).

Essential to any research endeavour is a set of basic assumptions that are implicitly or explicitly held by the researcher (akin to a theory-laden approach) and these assumptions, depending on the specific context of study, influence if not the outcomes, at the very least the "feel" of the study. This is obviously evident when reading works of individuals as the following simple example will suffice: reading the works of Jensen (1994) as well as Valencia and Suzuki (2001) puts the reader into different frames of mind, at times resulting in unease due to simultaneous acceptance of basic philosophies which underpin both expositions, and as these two "sets" of writers both make sense there is a conceptual and philosophical struggle between accepting one over the

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[11] That a radically divergent outcome should result is not anticipated.
[12] Taken directly from Joseph R. Royce but utilised in a somewhat different manner.
[13] Upon first glance these dimensions appear very similar to those of Jung. This seeming similarity was affirmed as Royce makes mention of Jung in his 1959 address in American scientist, although not directly in conjunction with the dimensions as stated.
[14] Although the two may at times be synonymous, it is noted that semantic confusion does exist about the exact difference embedded within these two concepts (Royce, 1973) although Madsen (1971) uses the two terms synonymously.
[15] That dichotomies exist at all is somewhat perplexing given the serious advancement within science and philosophy in recent decades. Why many continuums have to be construed as either all-or-nothing itself gives one reason to wonder. Perhaps this is a manifestation of deeper behavioural inner workings of the ever-evolving brain. Or perhaps it is really just a reflection of "the intellectual history of our society"; a Cartesian dualism left-over perhaps creating "separation rather than inclusion"? (Bateson, 1995). Is this tendency one of epistemological or ontological origin asks Rose (1995, p.201)? Here we go again - yet another dichotomous 'either-or' sentiment! Gould (1998) refers to this human tendency as a "propensity for division by two" (p.30) and is so widespread because so much in nature can be classified into two categories and thus is really just based on good observation. Also somewhat akin to the mathematical principle of the excluded middle, against which intuitionist mathematician Luitzen Brouwer ruled (Clapham, 1996) but more of this in chapter 4. It is interesting how the tendency to dichotomise manages to seep into the groundings of mathematics which results in the question of how "true" our mathematical groundings really are if they are given to the whims of our evolutionary heritage of looking at the world in a certain manner. This too has a bearing on how we fashion our tools of assessment and how we regard what we regard to be correct and true.

other. The question may be asked as to whether one really needs to choose between them in the first place – perhaps holding two supposedly opposite views would seem contradictory in some way.[16] For the time being remaining consistent is of greater importance. Not only are these issues important but the influential ties between them all is clearly evident as one works through the mind-brain problem right through to a discussion on static and dynamic forms of assessment. These issues are not isolated ones and often discussions within philosophy texts touch on each of these issues whether superficially or in-depth when detailing certain aspects pertinent to only one of these topics. In sum, these topics were chosen due to their pertinence to the topic at hand (dynamic assessment within intelligence) and because they overlap in content and subject matter. The following is neither a treatise nor a comprehensive survey of the terrain of issues involved, but allows the reader further insight into how the author's leanings colour the study of dynamic assessment within intelligence and it should be noted that some of these issues are not mutually exclusive but intertwined in many ways. These include:

- The mind-body "problem"[17]
- Consciousness
- G – dominated vs. multiple intelligence (MI) – dominated leanings towards the understanding of intelligence
- Emergence (irreducibility) vs. reductionism
- Realist vs. relativist approaches towards research
- Nature/nurture
- Static – dynamic assessment of intelligence and potential

2.4.5.3.1 Introduction

From the very start of investigation into the surrounding environment[18] (within and without) splits, divides and opposing beliefs have been the stuff of knowledge-gathering and inference and like all other knowledge-gathering activities humans' propensity to continually divide systems of belief is and always has been omnipresent. Is it really necessary that a belief be located on one of two areas on a continuum? (Jencks, 2000). Is there not a manner in which one can move beyond the "inadequacies of dualism?" (Shakespeare & Erickson, 2000, p.190). It is reasoned that this unfortunate set of events (an evolutionary product of the human brain?) at time colours and alters somewhat the views actually espoused or endorsed. Such dichotomies pervade all these issues (from the mind-brain to nature-nurture controversies for instance and even construals of how intelligence is to be measured in both verbal and non-verbal manners; Flanagan & McGrew, 1997) and to seek alliance with one or the other view is rather unfortunate. In the hope of not being pedantic, the author then too, has to align herself to some degree with various views that are located on just such a prototypical continuum. Cognisance is taken of this narrow-minded construal of events. There are always two sides to every issue and in order to support a preferred view it would be quite easy to merely cite those in favour of the author's leanings. Of course this is no good as academic debate and the discussions below include "for-and-against" views in order to properly debate the reasons for the choices made on each issue. As Williams (2003, p.9) cautions whilst referring to theoretical psychology as a discipline:

> we have been content to skate along the top of such issues, not getting into them too deeply, and not realizing that we all must take some position on these issues, and that we do so usually in an implicit manner without the benefit of careful and penetrating examination and contemplation.

2.4.5.3.2 The mind-body problem

That this issue is still problematic is telling of the status of received views concerning physiological findings (evidence) when transplanted into a philosophical context. Foregoing any attempt at an answer because the issue might be perceived as untenable and fundamentally undecidable (Bickle, 2003b; Koch, 1981) is not an option this author wishes to adopt. A strict type-type identity theory[19] is perhaps the seemingly closest alliance that can be made philosophically in terms of a view endorsed by the author; as it is believed that such an isomorphism (one-to-one mapping of mental to neural; or sameness of structure[20]) really does exist (Stillings, Weisler, Chase, Feinstein, Garfield & Rissland, 1995; Royce, 1959). However, due caution is

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[16] Unfortunately it often happens that questions within philosophy are answered by yet more questions. A frustrating phenomenon encountered within the study of philosophy (which is why this study is cognisant of philosophical viewpoints but is itself not a philosophical treatise).
[17] Inverted commas have been inserted as this is not perceived as a problem in the conventional sense and is quite anathema to the way the state of things appear to the author. For there simply is no problem evident. That this is contentious is not in question.
[18] Reference is made here to the very beginnings of humanities' obsession with understanding ourselves and the world in which we inhabit. Needless to say, science (as officially acknowledged and designated as such by an empirical method) is of course included.
[19] Also globally referred to as the psychobiological approach which states that the "mind" is a collection of brain processes and that behaviour is both controlled by and is a product of the environment and the central nervous system. Compare this to strict behaviourism which states that there is no intermediary mind as such and that behaviour really is just a stimulus-response system (severely criticised by, among others, Chomsky, 1959) and that of animism which states that the immaterial mind controls the body (Bunge, 1985; Butterfield, Slocum & Nelson, 1992).
[20] Although indirect and not, at this stage, related to a comprehensive theory of intelligence (Newman & Just, 2005).

attached to the interpretation of research results emanating from nascent developments in this domain (Gardner, 1986). To unequivocally remark that this isomorphic mapping is true and always the case would be an absurd proposition as identity theory itself was a reaction to the behaviourists' repudiation of inner mental events. It is itself vulnerable to presumptions it cannot explain away (Lycan, 2003) relying too heavily on human biology as ultimate explanation of events across time and space. However, to deny the leaning in this direction would be fallacious. The mere fact that terms such as "mental" and "physical" have to be delineated within this take on the mind-brain problem already colours the stance proffered. The author's leanings are towards the unification of the two concepts and that mind/brain are synonymous. Perhaps as Damasio (2003) has stated, "mind" is the creation of brain[21] the image of body implanted within the brain as neural networks in order to aid its survival. Cultural impingements either facilitate or hamper the adaptive functioning of the brain in the author's personal view. Time will tell whether cultural adaptations have in some measurable way aided in survival or militated against it (Diamond, 2006).

The year 1739, when Hume wrote of humans' personalities being "bundles of perceptions"[22] (Hume, 1981), is indeed quite remarkable when one considers that this idea is still debated some two hundred and sixty six years later (Kukla, 2001). As an early inductive positivist (Howson, 2001b), Hume's assertions that all complex perceptions (further divided into impressions and ideas and the occurrence of the resultant associationism which forms the basis of all intellectual operations) are built up from simpler perceptions and can be analysed into simple components is testament to his atomist approaches to the study of human ideas and sensations (he was influenced by Newton's inductive reasoning) (Capra, 1983; Delius, Gatzemeier, Sertcan & Wűnscher, 2000; Leahey, 2000; Mautner, 2000; Midgley, 2000; Oldroyd, 1986; Porter, 2004; Worrall, 2002). He thus inspired future logical positivists (Newton-Smith, 2001a; Ray, 2001) in which they recast his ideas into what is commonly understood as analytical (*a priori* experience-independent truths) which could not be proven invalid (Hempel, 1983; Turner, 1967) (see chapter 4 in which the discussion on mathematical axiomatisation was shown to be seriously flawed as formal mechanism of logic and in which the realm of the *a priori* as Platonic is discussed) and synthetic arguments (*a posteriori* experience-dependent truths) which are contingent on experience and so can be validated (Ernest, 1998; Fetzer, 1993, 2002; Heyes, 1989; McGuire, 1989; Quine, 1993; Turner, 1967). However, this strict materialistic monism[23] may be misleading (it being a more general label of several materialist oriented theories of mind; Churchland, 2000) since type-type identity theory as advocated does not necessarily analytically reduce mind to brain (in other words no independent status is granted to mental states although they are not denied; Eccles, 1989). Rather, it maintains that the two should be reduced to an equivalent class of property classifiable under different vocabulary (Maslin, 2001) which, as Watson (2005) states, may be the very problem and as such, "many psychological concepts, because they originate in language coined before the rise of science, are now outmoded" (p.42).

Perhaps our vocabulary is conceptually biased and inadequate to contain what is now understood to be the more correct meaning (Hall, 2000). Encompassed within the mind-body issue is a subsidiary issue of nativist and cognitivist views on language capacity and propensity.[24] After all, the nativist assumes a physicalist notion of language acquisition as opposed to the learning acquisition model posited by the cognitive learning school (Karmiloff-Smith, 2000). That language is unique to homo sapiens-sapiens however (as intimated by the nativists) is at this stage far from being resolved (Mason, 2005). This is evidenced by recent research detailing the region in the macaque's brain which controls jaw movements (serving as a direct homologue to Broca's speech area in the human brain). This finding is cited as evidence against novel neural pathways evident in only humans (Scientific American editorial, 2005; Petrides, Cadoret & Mackey, 2005).

The ceaseless debate and ongoing wrangling between opposing schools of nativist/cognitivist thought has however shed light on what was in the past an insurmountable and intractable problem. The jury has as yet to deliver their verdict on the matter once and for all, though it would seem that the nativist position is firmly entrenched in its place for the time being (Casti, 2001). Language, as developed within human beings, seems at this juncture in scientific history to indeed be a product of genetically mapped instructions. Although the exact details as to a ''mechanism'' (the Chomskyan view, Vosniadou, 1996a) within the brain has yet to be incontrovertibly detailed and accepted (it would appear that neurological underpinnings of this language mechanism is in fact a diffuse product of various coalescing features of the plastic brain; Casti, (2001); as well as a distributed as opposed to a unitary mechanism; Szentágothai (1989)). Firmer understandings of these and other issues can better be advanced utilising more empirical reductionist accounts. So-called "bridge principles"[25] or mapping relations (Looren De Jong, 1995; McGrew, 1997) are necessary in order to link psychological concepts with their physical counterparts and at each bridge

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[21] Damasio (2003) takes this idea from Spinoza's The Ethics Part II and is an idea dating back to the mid seventeenth century (Mautner, 2000).
[22] Curiously, compare this to Binet's "bundle of tendencies" statement referring to humans' complex make-up, quite contrary in basic philosophy to what Hume proposed (Wolf, 1973 in Sarason, 1976).
[23] Perhaps the term "naturalist" would be better utilised here as opposed to monist.
[24] This hierarchy may be faulty to some as it is not necessarily the case that the language acquisition controversy can be neatly placed within the mind-body debate. I have, however, chosen to locate it here for the flow of the argument.
[25] Meehl (2002) states that bridge laws are themselves only postulates or an "operational link" and by inference it might be stated that these principles too are at the mercy of theory appraisal as with any theory.

on this ''intertheoretic reduction relation" the disparate vocabularies will hopefully be connected (Bickle, 2003a; Kukla, 1995a).[26] As Lichtenstein stated over twenty years ago, cognitive psychology could find an allay in psychobiology as the mind-body identity theory was widely accepted by the two serving as connecting link (1980). Explanatory unification is the resultant future consequence with the hypotheses, postulates and laws of the one theory being reduced to those of the other theory (Churchland, 1986;[27] Turner, 1967) (such inductive realism will be discussed in chapter 3 along with intertheoretic reduction at both inter and intralevel theory explanation, see section 3.6). "The bridge laws establish connections between the two theories' predicates, providing grounds for the explanation of the upper-level theory and for the revelation that its entities are nothing but combinations of lower-level entities. Thus, in principle at least, the lower-level theory can, allegedly, replace the upper-level theory without explanatory or ontological loss" (McCauley, 1998, p.613). This bridging principle notion is highly contested though and it would be best to consider counter arguments so as to allow the debate to continue in a fruitful scientific manner (Howe, 1996). This type of theoretical unity concerns the amalgamation and explication of a number of observations via a limited set of explanatory mechanisms, referred to as causal-mechanical (Schouten, 2003) where the same explanatory phenomena can be utilised to explain aspects at different levels of analysis (Finlay, 1997).

Of course this take on inter-theoretic reduction is a nomological-deductive one[28] (Ettin, 1984) (and draws its main architecture from the logical positivists such as E. Nagel for instance and assumes that higher and lower level theories can be commensurate[29]). It stands in stark contrast to models presupposing that such reduction between lower and higher level theories will be incommensurate[30] as exemplified by Feyerband and Kuhn for instance, even though there are differences in the meanings attributed to incommensurate theories utilised by these two philosophers (Khalidi, 2001) or will founder due to a fundamental loss of information due to "translation" errors; i.e. when terms of the one theory are translated into the terms employed by the other (McCauley, 2001; Shweder, 1986). For it might be the case that not only do the different approaches utilise different languages but they may also refer to different phenomena (David, Miclea & Opre, 2004). Kukla (1995a) also cautions the reader to the fact that psychological reductionism as discussed above is based on "sheer conjecture" unlike some natural science counterpart examples of intertheoretical reduction (p.213); but unification via reductionism does not necessarily entail eliminativism (Barendregt, 2003) as already highlighted. In a manner, bridge principles can be equated with correspondence rules used for theory construction but there is as yet no systematic manner devised in which such rules can be sought in psychology between theories proffered and the data observed (MacKay, 1995). That this stance on mind-brain is the last word or that it has in any manner sufficed as adequate is of course a premature deduction (Gray, 1989). What is being emphasised here is the leaning towards this rendering of what constitutes the mind/brain. The crux is whether the theoretical explanation at both the neurological and psychological levels can be logically reduced to a single theory; and bitingly, Maddox (1998) states that it was inevitable that psychology was to become the handmaiden of neuroscience utilising "fancy names" (p.278) such as cognitive science to demarcate this change. Doubtless, his view can be contested. The fact that mainstream philosophy of mind remains indifferent to the findings of neurosciences in general (Bickle, 2003b; Mundale, 2001) is problematic and a main reason attributed to this indifference is the premise of reduction, a method followed within the neuroscience enterprise. It is doubly perplexing in fact when one considers that William James himself proposed physiological mechanisms underlying memory and behaviour as far back as his 1890 treatise on "Principles of Psychology" (Rosenzweig, 1998).

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[26] Conpare this to Hempel's (2000) bridge principles or connective statements which are necessary if reduction from one area of study is to be made to another. Although not quite the same meaning is implied here, Wilson (1999) posits four bridges or links that can be and are being spanned across the social and natural sciences divides, namely links emanating from the disciplines of cognitive neuroscience, human behavioural genetics, evolutionary biology and environmental sciences. The first two are of particular importance within the area of intelligence research and are ever-expanding areas of focused research efforts in this realm within psychology.

[27] Churchland (2000) however states that bridge principles will never be found because they will not be bridging anything as such, seeing that naïve psychological explanations are invariable wrong; "as the eliminative materialists see it, the one-to-one match-ups will not be found, and our common-sense psychological framework will not enjoy an intertheoretic reduction, because our common-sense psychological framework is a false and radically misleading conception of the causes of human behaviour and the nature of cognitive activity" (p.489). Most philosophers, states McCauley (1998) are of this opinion where "high level" theories proffering extreme reductionism within developmental studies for instance are not yet within our reach (Schlesinger, 1995).

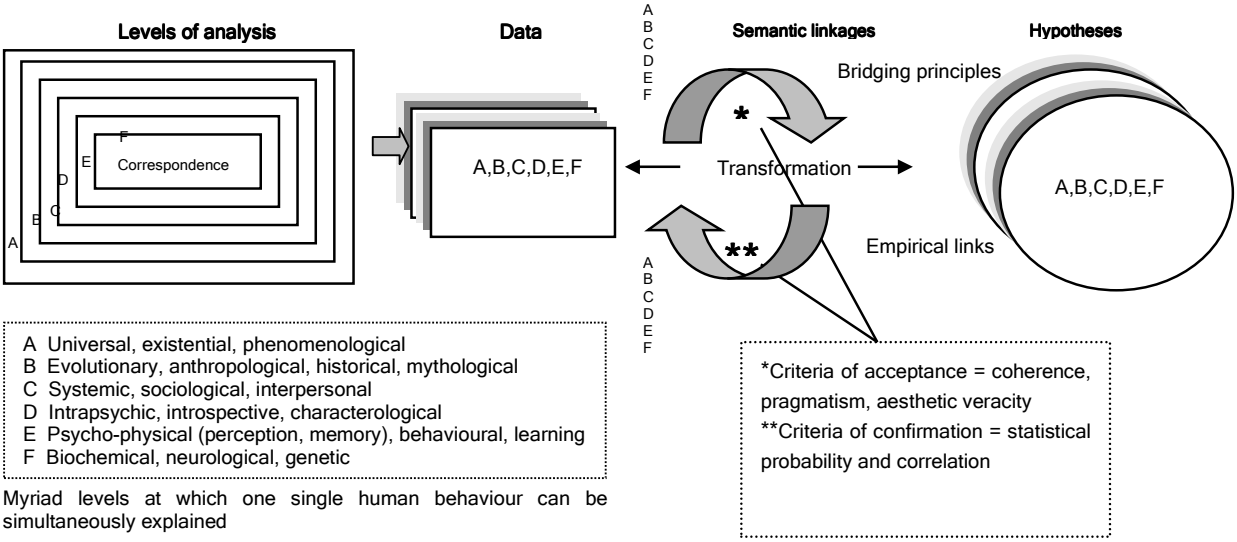
[28] Schouten (2003) states that one cannot necessarily equate deductive-nomological and causal-mechanical reduction systems of explication.

[29] In terms of meaning variance as well, for just as various same-level theories may utilise words in a different way so too might lower and higher level theories. The invariance of meaning was considered by the logical positivists as a given, but later advocates such as Feyerband, Kuhn, Hanson and Toulmin advocated that meaning is in fact variant across theories (Kordig, 1971). One can see the utility value of ascribing the same meaning to the same terms used within various theories; i.e. when physicists talk about gravity it is assumed that the meaning inherent in this term is invariant (even though the concept itself may undergo change; Chown, 2006). Can the same be said for psychology and assessment? The word intelligence for instance can hardly be said to be meaning invariant. Of course it might well be that a set of facts or data can (and should) be explicable by more than one theory (Copi, 1972; Faust & Meehl, 1992; Lamal, 1988) and hence the need for theory appraisal criteria.

[30] Of course there is no "winner" as such between competing theories as these theories are operating at different levels and should be viewed as co-evolutionary rather than as competitive (McCauley, 2001). The one discipline (neuroscience) does not seek to eliminate the other (psychology) but seeks to work together (Bechtel, 1988; Van Strien, 1987). Moreover, theories need not be revolutionary in nature to supersede mainstream theories (normal science period activity) but can, as Xiang, Anderson and Barker (1998) state reflect slow accretive changes permeating the realm of research.

Following from this train of argument and indeed logically consistent with the author's leanings in this regard is the parallel issue of dualism. If the aforementioned is doubted on any grounds, it is reiterated that no such dualism is warranted in order to explain functioning at any level and although not within the purview of current scientific progress, it is considered merely a matter of time before much else besides the mind/body problem receives even greater clarification. That there exists no such concept as ''thought'' within the brain reflects a naïve view but that the concept of thought should be placed in any category other than the category to which "neuronal activation" belongs is the essence of the type-type identity theory. As consciousness is often seen as the pivotal mystery within the mind-body debate (Ludwig, 2003; Nagel, 1981), it is this issue on which attention is next focused. Ettin (1984) offers a succinct overview of the "levels of description" analysis and it is here diagrammatised in figure 2 as it illustrates much of what has so far been discussed.

Figure 2 Relations between various fields of knowing and validity criteria involved (Ettin, 1984, p.217)



2.4.5.3.3 Consciousness

The statement that "social, psychological and cognitive sciences remain stuck with pre-scientific words and concepts" (Watson, 2005, p.44) may be contentious but a ring of truth resonates as Watson states furthermore that 'consciousness' among other concepts is in fact an imprecise term to describe what we think to be whatever it is consciousness is. As Blakemore (2000) emphasises in this regard, "so far we are not getting on very well" (p.221), an echo of Zimmer's (2005b) contention that such terms "have a way of slipping around in the semantic mud" (p.288). Consciousness is a term first used in English in 1601 by none other than Francis Bacon (Barrow & Tipler, 1996). That 'consciousness' may or may not be an idea worth pursuing or experimentally validating conveys the unease with which researchers are currently burdened (Plotkin, 1997; Singer, 1999). The idea that the concept and it's innumerable meanings and interpretations (Deacon, 1997) are intractable does not warrant researchers denying themselves the pleasure of in fact deciphering all that it entails, however the fact that homo sapiens-sapiens might not be *able* to deliberate beyond a very rudimentary level on this issue, is telling of how enclosed we are within our own system (or within our own heads/brains/central nervous systems).

That we might never be able to escape this prison of confinement and hence do justice to a more fully explanatory model has not escaped philosophers and neuroscientists alike (Dennett, 1995; Pinker, 1997). This line of thought is rather disconcerting to say the least and will not do if humanity is to proceed along a course of self-discovery. Perhaps then, a change of vocabulary or concept category is necessary, but we will not be able to deter the fact that consciousness (in whatever terms it could be described) will haunt us. Neural correlates; a one-to-one isomorphic mapping; psychophysical parallelism;[31] a ruthless reduction (Bickle, 2003a; Michell, 1999; Wakefield, 2001) of mental to physical may not always be a palatable exercise for some. The

[31] Considered as a prejudice of our time by Gödel and Wittgenstein (Wang, 1995).

extreme of this approach is evidenced by the writings of Penrose (1994)[32] (Horgan, 1994) for instance in which the very matter which allows for consciousness to emerge is what makes it untraceable – an epiphenomenon which is the cause but itself cannot cause anything. Our "conscious thoughts reveal to us so little of what gives rise to them" (Minsky, 1988), but it is believed by this author to be the best of the current repertoires of engirdled approaches on offer as this view is underscored by Ramachandran and Blakeslee (1999) whose sentiments echo those already alluded to, "I do think there is a new way to study consciousness by treating it not as a philosophical, logical or conceptual issue, but rather as an empirical problem" (p.228) and as has already been evidenced just such reductionistic goals have been achieved within a psychological framework (Kandel & Squire, 2000).

The view that physicalism is only good for explication at the functional and structural levels (Chalmers, 2003) is construed as an affront to the experimental approach, for in trying to shed light on a matter as difficult as this, any attempt from this side of the debate is considered a step forward. Consciousness[33] has always been enveloped within some sort of framework attempting to add credence to the concept and as such has travelled alongside structural (componential), functional, behavioural,[34] phenomenological, cognitive (computational) and systemic emergent psychological movements which pepper the historical progression of psychology (Maree, 1995; Spiker, 1989) and has been studied from a plethora of viewpoints and angles.

That this empirical problem can be studied from a evolutionary stance is perhaps an even better programme as it allows researchers to understand the gradual (not teleological[35]) progression of how and why this state of affairs (consciousness) arose in the first place (Damasio 2003; Dennett, 2003), much akin to the value that intelligence confers on behaviour (Johnston, Partridge & Lopez, 1983). In this regard behaviour and consciousness is viewed as an emergent phenomenon (Horgan, 2000) or property of the brain which allows for a more accommodating adaptation to the environment. Although precisely how this is done at the neuronal level is not yet known, (Grossberg, 1997), which is a notion espoused by the functionalist school of psychology advocated in particular by William James[36] (Maree, 1995). This is a start towards a solution, an effort that will garner many specialists' views, opinions and research results for many decades to come.

2.4.5.3.4 G–dominated vs. multiple intelligence (MI) – dominated leanings towards the understanding of intelligence

A more sensitive, contentious, emotionally overwrought, discordant and dissenting and at times adversarial issue is hard to locate within the annals of intelligence literature and it is for this very reason that at the outset of a study such as this, it is considered prudent to particularise the author's affiliations regarding *g*.

The issue of *g* as presented briefly here is of course an issue more complex than when it first made it's appearance in scientific journals in 1904 (Gould, 1997a;[37] Spearman, 1981). Moving beyond the original confines of *g*-related research, newer models now exist which, although fraught with their own problems, offer a less restrictive conceptualisation of what *g* in fact entails (Bowman, Markham & Roberts, 2002) and a simple straightforward avowal of *g* is certainly not what is intended when leanings are said to go one way or the other. As performance-based tests become increasingly used in many settings, *g*, as originally conceived of during the 20th century, will play a less dominating role in assessment (Sternberg, 2003a) not to mention the fact that *g* is not unlike the definitive feature of intelligence. That it posses no clear definition (Horn, 1988) but to conform to current dominating views of *g* as understood within the psychometric community, one could perhaps state that *g* or GMA (general mental ability) "is a general information-processing capacity and is extracted as a general factor (the first unrotated factor) from a battery of specific ability tests" (Ones, Viswesvaran & Dilchert, 2005, p.431). It represents "decontextualised reasoning ability" (Brody, 2005, p.492). *G*-supported research and its rivals periodically swing from the descendant to the ascendant (Stankov, 2005b) and context (research climate, funding, general views permeating the field) by and large dictate when and where it is

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[32] Who explicitly states that he is *not* identifying consciousness with quantum mechanics per se; rather "it is my view that solving the quantum measurement problem is a *prerequisite* for an understanding of mind and *not at all* that they are the same problem. The problem of mind is a much more difficult problem than the measurement problem" (1994, p.331).
[33] In whatever terms it has variously been described throughout the ages and throughout cultures.
[34] A framework where it was out-and-out denied.
[35] Arguments referring to "causal explanations in which some of the antecedent conditions are motives of the agents whose actions are to be explained" (Hempel & Oppenheim, 2000, p.64). Evolution as such is not going anywhere for instance, "it" is not moving towards a "greater" or "better" design of the brain. If it so happens that the environment were to somehow favour those with smaller brains then it might well occasion that smaller brains become the order of the day; human brains did not enlarge *because of* anything, those humans evidencing larger capacities were favoured and as such reproductive success enabled generation of those individuals' genetic material (Gould, 2000a).
[36] Very prescient, as this is often considered a rather modern idea.
[37] As much as this author is a fan of Gould's prodigious output it cannot be ignored that his original 1981 edition of "The Mismeasure of Man" itself came in for much criticism (cf. Carroll, 1995 and his legitimised criticisms; Deary & Smith, 2004; Jensen, 1982a (partly in an attempt to defend himself from uncritical attacks from Gould)). Gould's philosophy concerning human ability and growth is a like-minded concern and as this study has as its main subject dynamic assessment this further supports the authors leanings too in the direction of human change and growth. However, alternative philosophies as espoused by eminent scientists such as E.O. Wilson and A. Jensen for instance also cannot be ignored and it is with the latter that this liberal philosophy is attenuated (cf. Jensen's 1982a rebuttal to Gould's "attack").

emphasised. A distinction needs to be drawn between what one considers a general *g* as implied by an all-encompassing, ever-present general level of functioning that can be explained at even the most rudimentary and naïve folk psychology point of view through to the very strict mathematical psychometric *g* envisaged and "found" by Spearman[38] and held up as evidence of a unitary element representing all there is to intelligence (Detterman, 1982; Irvine, 1987; Sternberg, 1991) and in onto the "microanatomic or biochemical features of the brain [which are] involved in the heritable component of *g"* (Meehl, 1998, p.3). Spearman's envisaged *g* as evidenced from his tetrad correlations was a Platonic attempt at revealing hidden structures of the intellect (Brody, 2005); the Platonist realm of investigation is important in this thesis for this very reason and is discussed later in chapter 4. *G* as evidenced by statistical decompositions and *g* as expressed by less abstruse means (academic vs. ordinary discourse) are both considered hereunder and within the view taken by the author. It is perhaps no co-incidence, or at the very least it should come as no surprise that Spearman is also credited as having partially developed the theory of true score and error score along with Yule, especially as the nascent development of correlations played a pivotal role within both *g* research and the true score model of mental testing (Crocker & Algina, 1986; Fischer, 1996; Ghiselli, Campbell & Zedeck, 1981). Assessing for a trait considered unchangeable (Spearman's *g*) via a means of stability testing (Spearman's test theory) can perhaps be considered two aspects tying up on tightly knit conception of what intelligence is and how best to measure it (Dennis & Tapsfield, 1996; Kyllonen, 1996). Is it possible to conceive of a past in which intelligence was not considered a unitary concept and for which subsequent alternative statistical techniques were devised to test for such multidimensional traits not regressable to *g*? Fluid and crystallised *g*-based models and three stratum models all hark back to the ever-persistent *g* or some form of general factor[39] (Carroll, 1997b; Keith, 1997; McGrew, 1997). In the words of Deary (in press) "*g* is a highly consistent and an interesting finding, *g* is substantially heritable, *g* matters in life"; concurring with McCallum and Bracken's (1997) non-verbal intelligence tests which are founded upon the measurement of pervasive *g*. Note that what is being stated is not that fluid *g* is in fact psychometric *g* as is frequently asserted as well as argued for and against (Anderson, 2006; Benga, 2006; Blair, 2006; Demetriou, 2006; Kaufman & Kaufman, 2006; Voracek, 2006) but that this may be the case; this issue is far from any clear resolution. Would the establishment now be saddled with similar nagging issues if *g* did not haunt research results? This thought experiment may well manifest in an approach to change-assessment predicated on fluid *g*. Till such time avails of such techniques, it seems likely that mainstream assessment will have to continue its somewhat dubious role of foundationary mechanism, upon which rests change-based philosophies of assessment. Currently, though, *g*-based and the more intuitively appealing multiple intelligence-based leanings are equally represented in the literature (Hopper & Hurry, 2000; Stankov, 2004).

That *g* has played the role of harbinger of the hereditarian-influenced views is evident especially since Pearson was granted a Galton professorship (and completed the work Galton had started on correlations; Hughes (2000); Kevles (1997)). Galton was considered the founder of formal testing (he coined the term "mental test" but seldom used the word "intelligence" and never formally defining it either), was the inventor of statistical correlation[40] and is considered the father of differential psychology (Ittenbach, Esters & Wainer, 1997; Jensen, 1998b; Millar, Millar, Millar & Millar, 1996; Nunnally, 1978). He was Darwin's cousin and thus firm believer in attempting to mould intelligence to the same framework utilised in evolutionary mechanisms described by Darwin (no date; original 1859; Crocker & Algina, 1986; Kevles, 1997; Madsen, 1988; Sahakian, 1975).

Fusing statistical[41] ideas from Quetelet (1849) who imported the idea of the law of error from astronomy into the social sciences (Gigerenzer, 1991; Lazarsfeld, 1977; Stewart, 1990; Stigler, 1999) and his cousin's ideas on the favoured transmission of hereditarian traits alongside Locke's associationism[42] and ideas regarding sensation as key to knowledge as well as Fechner's psychophysical ideas (thus introducing probability-based modelling and inference into psychology; Stigler (1999) and adversely

[38] Who later adopted a rather less severe strict *g*-view and opted for the specifics as well as general intelligence (Nunnaly, 1978) but it must be noted that Spearman did indeed discuss a "hierarchy of intelligence" and included in this hierarchy specific intelligences, although the underlying global intelligence was evident to him from the correlations be obtained between four school subjects thus leading him to ascribe *g* as the reason behind high correlations between any two tests (Spearman, 1981; Thorndike, 1997).

[39] These models do not advocate *g* as such but the strata converge back on *g* as initial layered structure. As they say, you can run but you can't hide! *G* is there….somewhere.

[40] Albeit in crude form. Galton was not only a statistician but explorer, anthropologist, inventor and of course eugenicist (Pickover, 1999; Simonton, 2003).

[41] The history of statistics within the social sciences is quite a colourful one which will be discussed at length later on in this study (as it pertains to intelligence assessment). Of note here is that before Spearman utilised his approach to derive *g*, Wissler's 1901 pioneering study was the first to utilise the correlation coefficient method and preceded him in so doing (his study did not find robust correlations between basic processes and performance in tertiary education courses; Detterman, 1979); although Pearson had already evolved the mathematical formulation for the technique originally thought of by Galton who supported Pearson in his work (Carroll, 1997a; Du Bois, 1970). The term correlation coefficient was first used as such in a paper by Krueger and Spearman in 1907 (Du Bois, 1970). The psychophysicists of the early twentieth century (for instance at Titchener's founded laboratory in the United States) were not convinced of the efficacy and relatedness of the more developmental approaches favoured by Binet and to strengthen the blow delivered to intelligence testing in the early days, correlation coefficients yielded nothing substantial in terms of how simple psychological processes were related to intelligence (Brody, 1992). That correlations were fundamental in the construction of the research domain that is intelligence research cannot be over-emphasised (Detterman, 1991).

[42] Compare to Hume's ideas on sense-impressions in the brain which does constitute mind. From the very start of intelligence assessment the ideas and philosophies of Locke and Hume were very evident. Locke, of course, having conceptualised a framework of modern empiricism (Baker, 2001; Kukla, 2001). E.L. Thorndike was an early pioneer in the study of associationism which itself served as prelude to the behaviourist movement (Benjafield, 1993).

influencing proceeding generations in terms of what it means to "measure" in psychology; Michell, 1997, 1999; see chapter 4), Galton came forth with what at the time can be seen to be indeed revolutionary ideas (however incorrect and questionable they has since proven to be) (Brody, 2004; Huysamen, 1980; Stankov, 2005a; Thorndike, 1997). Once again this unfortunate dichotomy forever separating issues along a supposed manifest divide often skews what beliefs belie certain staunch views. Dichotomies too pervade the sphere of personality research evidencing a grave injustice to an area of investigation which is already suffused with intractable problems which it has yet to sort out (but will most likely not, due to the nature of the subject matter which is perhaps better left to less contrived modelling of human behaviour within the behavioural genetics realm). Take for instance the numerous dichotomies associated with pathological source traits where one is assigned an index score allotting to a "side" on the theoretical (not empirical) continuum (Smith, 1988). According to the manner of answers, the degree to which items are endorsed and the pattern of repeated endorsements one is labelled as "low bored depression" if one has validly endorsed items eliciting thoughts about one's behaviour that are considered "relaxed, considerate and cheerful with people" and quite the opposite in the case of "avoids contact and involvement with people, seeks isolation, shows discomfort with people". The very first question that arises from this situation is how consistent is such a representation? This bears on its veracity as reflective of the "true personality". There is as yet no definition for personality quite apart from the fact that we presume to measure it nor does there appear to be a similar *g*-type notion associated with personality (Stankov, 2005).

Time can often be a great equaliser and as such lower-performing individuals when confronted with subjects at school, may blossom later on in life much to the chagrin of higher-performing cohorts; reminiscent of Plotkin's (2003) view on intelligence and genes; "intelligence is caused by genes; the consequences of intelligence, however, cannot be reduced to genetic explanation" (p.81). The interplay of biology and environment results in either a dampening of what genes might harbour or a veritable explosion of growth, the capacity of which is enticed by a novel and accommodating environment. Notwithstanding the positive changes occurring throughout life, the situation may equally often present with lower-performing individuals who will forever remain so. Such nihilism is not unfounded but perhaps another term will be better utilised and shall henceforth be referred to as realism. It goes without saying that should the author have ever felt inclined to espouse such dark ponderings such as a deterministic written-in-your-genes scenario a study dealing with dynamic assessment would never have been attempted. Dynamic assessment by nature and definition assumes (not just espouses) and presumes a basis from which change within an organism is evident. That this propensity to change never existed is anathema to the very core philosophy of this approach. Change is and always will be a possibility, this is not in question and that dynamic assessment is a vehicle or tool with which such change is guided is also not in question. What may be in question though is the very basis or predetermined layer of instructions evidenced in every organism that has ever existed on the planet.

A pre-wired written set of protein instructions forms part of such a basis and however malleable the phenotype (measured variance accounted for by the genetic differences between subjects; Lynn & Vanhanen, 2002 and what IQ strictly is, i.e. a phenotype; Jensen, 1998b) may be, it is questionable how plastic the genotype will prove to be.[43] The systematic decomposition of phenotypical traits to genetic and environmental traits[44] is of concern to heritability-of-intelligence supporters (Grigorenko, 2004a). Current biometric genetic theory utilises mathematical relations underlying componential measures assumed to be a continuous distributed trait, in that the effect of individual genes combines to form the genotype (McArdle & Prescott, 1997) which with appropriate genetic targeting research can result in phenotypical modifications (Silva & Giese, 1998). To pronounce that the speed of neural conductivity (the chronometric approach[45]) *is* intelligence is questionable; that it may be correlated with intelligence and cognitive ability is not (Reed, Vernon & Johnson, 2004).[46] Many well-utilised intelligence batteries encompass mental speed tests (Danthir, Roberts, Schulze & Wilhelm, 2005) although it is noted that reaction time and psychometric speed research are not at all synonymous. To reify and raise intelligence as a construct (entity) to status not befitting it is likewise erroneous and very misleading and at times tows the line between justice and injustice (Ackerman & Beier, 2005; Bardis, 1985). It s an activity which Coulter (1997) accuses cognitivists of practising when construing mental and experimental aspects as neural. To likewise make manifest a mathematical construct such as *g* (Neisser, Boodoo, Bouchard, Boykin, Brody, Ceci, Halpern, Loehlin, Perloff, Sternberg & Urbina, 1996) too may be misleading, yet this is not to gainsay the role that the general intelligence factor plays in more often than not engulfing lower-levelled hierarchical specificities (Daniel, 1997). This is particularly so when one considers the tools utilised to make *g* manifest, namely factor analysis, perhaps the key statistical technique utilised in intelligence research (Keith, 1997). The first general factor is almost always *g* which, after rotation, is still manifest as main source of dominant variation within other rotated factors; so in essence it does not disappear (Ree & Earles,

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[43] This is so rapidly becoming an incorrect postulate and unfounded axiom of truth; the facility and tenacity with which gene sequences are currently being explored runs counter to the notion that one is forever "fixed" from birth. That this fixedness will remain so for very long is debateable. The question now arises as to what humanity will do with this information.
[44] Phenotype is the result from genotype-environmental interaction (Waldman, 1997).
[45] Which utilises easy tasks but has been evidenced to be correlated with intelligence the more difficult the task becomes; Beaujean, 2005 which is similar in nature to the usual findings on intelligence tests where more difficult tasks correlate to higher degrees with IQ than less difficult tasks with concomitant increases and decreases in the heritability quotient.
[46] More specifically such evoked potentials are often associated with psychometric intelligence (Eysenck, 1988) (as opposed to other conceptions of intelligence!)

1996). Problematic in early ventures attempting to discriminate biological and neural patterns via behavioural or "mental" assessments was the lack of fit between methodologies directed at different levels (Bigler, 1994). Progress on many technological fronts within the neurosciences is allowing for a more inclusive approach towards the study of intelligence from local levels of brain functioning (Duncan, Seitz, Kolodny, Bor, Herzog, Ahmed, Newell & Emslie, 2000; Willerman, Schultz, Rutledge & Bigler, 1994).

Belief in many types of intelligences is a comfort not afforded by other more *g*-dominated intelligence theories (which may view multiple "intelligences" more as forms of "talents" than separate intelligences per se and was propounded by E. L Thorndike over eighty years ago; Greenspan & Driscoll, 1997; Neisser et al. 1996) but to rest-assured within the boundaries of multiple intelligences can be misleading. Surely this take on intelligence allows all-and-sundry a place in the sun without leaving anyone remaining in the shadows, as it is hoped that no individual shall be devoid of even the slightest hint of a propensity towards some kind of intelligence.[47] A more altruistic appeasement within intelligence assessment will be hard to find. Is it the duty though of intelligence research to find a place for everyone? Or is it to further explore and explicate on the notions of what intelligence may possibly be and how it can most fruitfully be assessed and brought in to work for humanity in numerous beneficial ways? Just as intelligence as a concept is not a reified thing but a construct measured and made manifest through statistical methods, so too can one refer to *g* as just such a construct – the product of factor analysis; a construct which multiple intelligence theory does not deny but which seriously questions its explanatory importance. Moreover, this general factor seems to dilute across a range of intelligence-related tasks (Chen & Gardner, 1997; Ittenbach, Esters & Wainer, 1997; Sternberg, 2004c; Walters & Gardner, 1986). However one chooses to explain *g,* the point is that it seems to be evident in numerous assessments; assessments which are, some may advocate, really just the same type of measure and that it is not *g* one is measuring but ensuring the measures that are used converge to same construct as before, namely *g.* That it has proven to be difficult to obtain group factors that are not dependent on *g* regarding heritability of genetic traits within the psychometric model of course does not necessarily indicate a similar paucity when viewing the problem from an information processing approach (Plomin & Neiderhiser, 1991). This leads the argument to areas of methodological inquiry and the degree to which various levels of inquiry are able to handle these aspects. The author affirms her support for the existence of the notion of *g* (in its psychometric and biological correlates guise) despite contrary "evidence" which has become evident in the literature over the last thirty years. The context in which this research is conducted has unfortunately tainted *g*-supported research when in fact this area of study can very accurately and scientifically be researched and defended. Jensen's (1998b) comprehensive portrayal of evidential arguments against *g* theory is briefly summarised below. Reproducing summaries in a study such as this is not a practice one could reflect on as advancement of the discipline, but the counter arguments offered by Jensen are tantalisingly succinct and support and further buffer the notion of the existence of *g* as psychometric construct.

Summarised Jensen arguments against *g* and interspersed authorial opinions

Verbal arguments

1. The specificity doctrine – in which it is argued that intelligence is really only what has been learned in specific contexts and that these contexts are biased towards the ruling majority view. Currently in vogue among liberal circles and certainly a view point to advocate when writing proposals for funding. This sentiment is harsh, yet rings true
    a. *Intelligence as learned behaviour* – in which it is argued that intelligence is resultant from stimulus-response type scenarios. This extreme approach fails however to account for correlations between dissimilar test batteries (which *g* underlies) and such views invoke "learned behaviour in terms of its generalities" argument. This is not compelling least of all because there really is no way of proving this. Strict behaviourism is also unable to account for interitem correlations. Novel tasks are equally novel to an array of intellects and past learning can hardly be cited as evidential if none have been exposed to such novelty prior to testing
    b. *Contextualism* - often taken in tandem with relativist thoughts on what intelligence supposedly is or represents. As defined within this approach, intelligence can only be understood from the context which houses it but this goes no way towards offering reasons as to the disparate scores within one context. In other words, differential psychology is null and void which we know not to be the case

[47] Which brings this argument down to the very fundamentals of how "equal" humans are in terms of intelligence (as a construct measured at a specific period in time with a specific instrument). Jensen's (1980) "egalitarian fallacy" springs to mind, a fallacy he maintains incorrectly assumed equality in all respects concerning any trait or ability across all groupings and before this view is turned into a misconstrued one tainted with negative "socio-biology" ideas, the author cites Dawkins on the role of nature, which "is neither kind nor cruel but indifferent" (2004, p.11).

Mathematical and statistical arguments

These arguments assume a more robust mantle in terms of their sophistication and argumentation and cannot be as easily dismissed as has been done with those above.

1. Guilford's "structure-of-intellect model" – recalled by Jensen as a pseudoscientific attempt at discrediting Spearman's *g*. *G* in fact underlies his numerous abilities which he erroneously suggested did not exist. *A priori* presumptions surrounding the non-existence of *g* resulted in applying methodology specifically attuned to not locating *g*
    a. *Zero correlations between abilities* – Guilford's conclusion reached about non-significant correlations between cognitive tests has since been revised as a number as problematic issues have since surfaced including sampling error, restriction of the range of talent and measurement error. No scientifically valid evidence presents when Guilford's research conclusions are scoured for "evidential" claims
2. Sampling theories of Thorndike and Thomson – Thorndike's rendering of *g* did not gainsay the views of Spearman entirely (Thorndike reached these conclusions before Spearman's 1904 publication) but considered *g* as manifest linkages made between what, at the time appeared to be understood by Thorndike to be "bonds" or synaptic connections. Different test items would result in various bonds' being activated and varying tests would activate similar bonds hence the connection between the tests. People would thus have different bonds and inherently more or less than others. Hence, a connectionist understanding differed from the unitary understanding of explaining away *g*. Thomson was sought after and was offered a position by Thorndike and his main contribution to the *g* controversy consisted of his mathematical and statistical formulation of Thorndike's contention. Of importance in this argument is Thomson's convincing support for the notion of an extractable factor, such as *g*, but to infer the notion that this represents a unifying mental construct cannot be logically nor scientifically deduced as necessary concern. Thomson's rendering of sampling theory as underlying common factors cannot however be falsified. (Assuming for the moment that one subscribes to the tenet of falsificationism; see chapter 3).
    a. *Cognitive process theories* – relating specifically to elementary cognitive processes which form part of many cognitive tests assessing for speed and accuracy of information processing as loading highly on *g*. Jensen's stance on such elementary tasks research and its implication for *g* is understandably contentious
    b. *Behavioral repertoire theory* - cannot be accused of discounting *g* but it's main advocate, Lloyd Humphrey, construes *g* as general intelligence resultant from Thomson's sampling theory but utilised phenotype as unit and not genotype. Jensen does not argue against this as he cites this theory as not denying *g*'s veracity but merely offering an alternative angle. *G*, according to Eysenck (in Jensen, 1998b) cannot be defined in terms of its consequences (underlying structure) but rather defined as that which results in such underlying structure. This harks back to the nature of the statistical construct which *g* appears to be in terms of this argument (*g*, as is known, is also considered as more than a theoretical construct)
3. Cattell's theory of fluid and crystallised abilities – factoring fluid and crystallised intelligence in support of two general factors in contradiction to a general factor has led to much research into the nature of fluid and crystallised intelligence. Yet, in essence, *gf* accounts for *gc* variance. The correlation between *g* and *gf* has resulted in conclusions affirming their "one-and-the-same" status. More large-scale research is however needed to attest to these findings
    a. *Width and altitude of intellect* - E.L. Thorndike's conceptualisation of the breadth of knowledge (information known) and height of knowledge (complexity or difficulty of items) were originally conceived as similar to *gf*-*gc*. Not surprisingly they are in fact correlated which accounts for some constant underlying both width and altitude
4. Multidimensional scaling and Guttman's radex model - which, as with others above, has been incorrectly cited as not supporting *g*, merely due the label's omission. The spatial rendering of the closeness of various tests to one another represents their relations and suggests analogous *g*-like characteristics.
5. Gardner's seven "frames of mind" and mental modules - Gardner's theory of multiple intelligences is an instance of intuitively appealing framing of intelligence theory within the larger discipline but as yet remains unconvincing in its evidence to buffer its claims. Abilities and intelligence are not synonymous constructs and the empirical evidence surrounding the claims are scant. Thus it cannot be leveraged against *g*
    a. *Modular abilities* - Jensen is particularly incisive in his arguments regarding the neurological basis of modular abilities stating once again that *g* is a statistical construct accounting for positive correlations among tests and need not be invoked as supportive for neurological unity. That *g* may or may not have a physiological basis is another question altogether. A third order factor resulting from individual difference research and neurological modular bases of intelligence are completely different aspects of investigation
6. Sternberg's componential and triarchic theories of "intelligence" – is cited as supportive of *g* and is in fact contrary to what popular understandings may allude to. *G* is in fact part of this theory when more closely scrutinised.

Differing methodologies mandate other techniques not in keeping with other models, for instance the information processing approach vs. the psychometric approach towards the study of intelligence. Spearman did not contend that *g* was a biological modular capacity located within neural substrates, nor did later psychometrists (Glymour, 1997), notwithstanding research which attests to *g*'s location within a single cerebral location namely the frontal lobe and it's other main explanatory role, that of working memory (Deary & Smith, 2004; Hambrick, Kane & Engle, 2005). Many British contenders vie for the explanation of why *g* will for

quite some time be an aspect of intelligence assessment (Brand, 1985). Perhaps it is timely to venture forth what might be considered an unpopular sentiment and to echo the notion of what has already transpired above, that the term "intelligence" is an outmoded and ill-defined concept with which to pursue research on this front (Jensen, 1994). Practitioners and researchers are saddled with somewhat of a conundrum: intelligence testing assumes that what is being tested is intelligence but intelligence is so multifarious that in order to measure anything one needs to know what one is measuring, and in so doing the whole is broken down into componential parts and re-integrated back into the whole again, leaving one at times none-the-wiser for what has transpired. Hence, long before testing is a consideration it would make sense to first have some idea as to what the instrument will measure (Hunt, 1994).

Perhaps one can reduce the concept of intelligence to an equivalent of neural efficiency or as a product of networks of cortical areas (Davidson & Downing, 2004; Eysenck, 1986; Lashley, 1930;[48] Newman & Just, 2005) or some such physicalist account – as has been done with the terms "consciousness" and "mind. If this appears too over-simplified an approach at the very least the methodologies may well be complementary (Neufeld, 2002) in their common strivings towards doing justice to understanding more of what the concept "intelligence" has to offer. To reduce intelligence to biological and neural levels is rather similar in nature to the quandary in which the study of consciousness is found, and attempts through the ages to do so have often met with little success (Matarazzo, 1992; Schafer, 1982) even though comments such as those by Callaway (1985) evidence contrary sentiments "the fact that intelligence in humans has a biological basis seems too obvious to merit serious discussion" (p.223). Perhaps when an extrapolation is made from mind-consciousness-intelligence through to "psychology" a similar sentiment accompanies the attempt to try and explain what in fact is meant by psychology – another outmoded word unable to wrench itself away from embedded meanings which has since its formal founding as a science been unable to stand alone as a method of investigation into what makes humanity human.

2.4.5.3.5 Emergence (irreducibility) vs. reductionism

This particular aspect is of great importance as the issue is wholly intertwined with the issues of consciousness, nature-nurture, intelligence and mind-body problems. Causal inference as a goal of science is very closely aligned with the reductive imperative,[49] which seeks explanations as its most mechanistic level (Ryan, 1970; Von Bertalanffy, 1970). Radical reduction may well lead to answers to questions focusing on the very specifics of an issue and were it not for this scaling-down of reality, little would be accomplished in the understanding of how things work at a very limiting level. For instance, treatments for Alzheimer's patients benefit in profound ways due to work conducted at this reduced level (Lozano & Kalia, 2005; Rolls & Treves, 1998; Schmiedeskamp, 2000; Zimmer, 2005a). Bunge (1985) offers supportive arguments for the case of reductionism within psychology emphasising that the case of reductionism is not really eliminative as such (Barendregt, 2003) but rather one of integration.[50] Reduction of mental to neural does not mean that psychology becomes physiology; rather

- Neuropsychology contains information not only about the neurophysiology of behaviour but also information on the neural systems and functions including both environmental and genetic influences on behaviour
- Traditional psychological findings guide neuropsychology and neurophysiology; for instance by understanding the perceptual system and how it relates to and is related to the whole organism
- Neuropsychology unlike neurophysiology does not study humans detached from their social environments[51]
- Neuropsychology is not a branch of neurophysiology but rather a parallel endeavour into the understanding of human behaviour via data from the biological branch.

From what has transpired above, it is hardly surprising that the author affiliates herself with a more reductive side to explanations of things unknown but this does not necessarily imply that a strict hierarchy of science is a given (Schouten, 2003), even though this sentiment was core to the logical positivists. Psychology has tended to monitor the behavioural level only but that this level should be studied in isolation from the neural and genetic levels is questioned (Merzenich, 1987; Parisi, 1996). Ideas and notions as to what constitutes behaviour (including growth and change – the subject matter with which these areas

[48] An instance which illustrates psychology's lack of momentum in certain areas of research and human understanding – once again affirming the notion that the field is too undefined as a whole and should seek to fragment before synthesis can occur. A contentious, unpopular and sentimental view perhaps, but a view which necessitates a constant re-evaluation of where psychology is currently and more specifically where psychology positions itself within intelligence assessment.
[49] In agreement with Segerstråle (2001) and in contrast to what is often taken to be the case, reductionism within psychological research and especially intelligence research does not imply biological determinism.
[50] The author maintains that integration here refers to specificities within psychology which are amenable to reduction via bridge principles and does not advocate that psychology as a discipline will become unified as such (Krech, 1970; Von Bertalanffy, 1970). Various areas are open to reduction but the entire arena of psychology is not and should not be seen as striving for unification as all the multitudinous agendas are simply too vast.
[51] A new journal entitled "Social neuroscience" which will publish its first issue in 2006 "attempts to explain the psychological and neural basis of social and emotional behaviors in humans and animals. It is a new multi-level integrative analysis approach, rather than solely biological or social" and will feature articles "that examine how the brain mediates social cognition" and looks at the "role of the central nervous system in the development and maintenance of social behaviors" (http://www.social-neuroscience.com/).

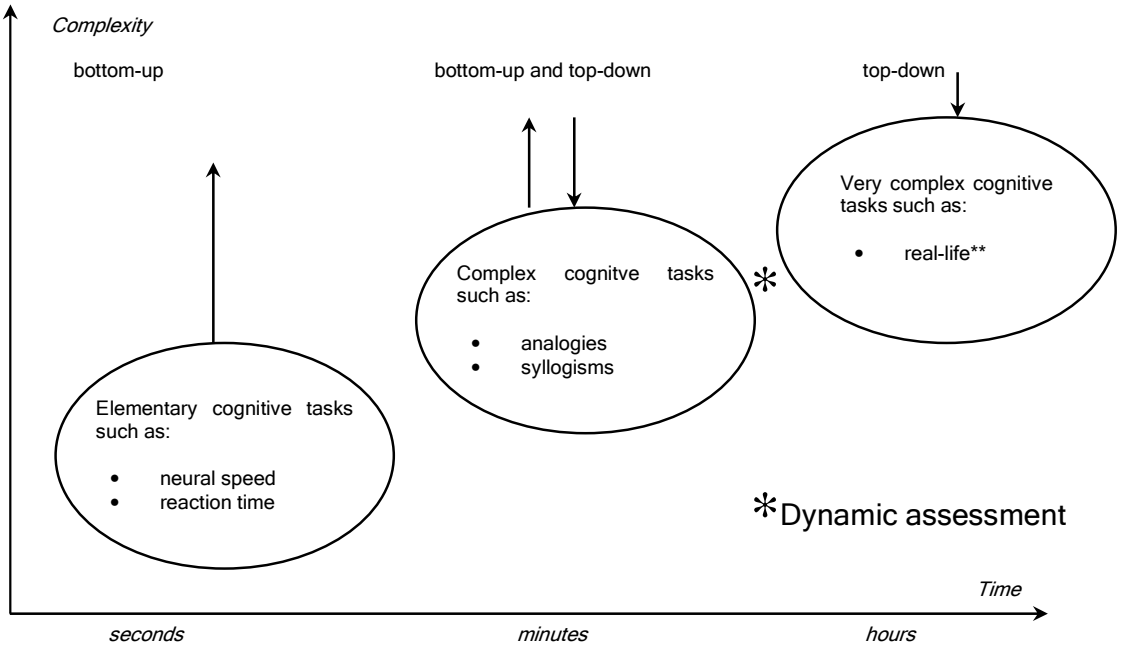
concern themselves) could be profoundly altered in view of new evidence from other levels of description. This notion was being pondered within psychology as early as 1930 (Lashley, 1930) so can hardly be considered an enlightened view. Evolutionary psychology, for instance, seeks to describe human functioning from three integrated and mutually influential bases; namely, the neurophysiological, cognitive and adaptive bases (Fikes, 2001). Hierarchies of emergent intelligent functioning via the evolution of different brain regions are tantalisingly parsimonious (Pascual-Leone & Johnson, 2005). Seeking to explain behaviour from a biological position which considers humans' past and evolutionary cognitive development is laudable on grounds that we are, essentially, biological beings and more specifically our cognition is historically based within situated human collectives (the emphasis on anthropological models of mediation and cognition) (Toren, 1993). In fact Van de Vijver and Jongmans (2002) have already indicated the potential for a biological correlates approach within a dynamic assessment paradigm with Lidz (1981) having indicated the need for inclusive neuropsychology within assessment more than two decades ago. However, the resounding call from Budoff (1987a) and Entwistel (1987) that biologically based attempts at intelligence measurement (also concerning educational assessment) is doomed to failure due to intelligence being socioculturally influenced is heeded (Fodor maintains similar sentiments regarding psychology as a discipline; Crosson, 1985). Also, neurocognitive perspectives on learning theories are receiving more attention from within the education domain (Anderson, 1997). Researchers had, as early as 1949, considered the biological and neurophysiological foundations underlying learning ability noting that improvement in learning ability might be due to changing metabolic processes underlying neural activity (Eysenck, 1986). The interdisciplinary nature of some literature attests to psychology's contributions to neuroscience and vice versa (albeit not quite to the same extent). Yet far fewer educational insights are attended to in the works of neuroscientists (Friedman & Cocking, 1986) – an area lacking within the discipline and especially dynamic assessment, for it, as an applied version of psychology, would benefit tremendously from educational insights interwoven into neuroscience texts. What are the neurological benefits derived from instruction? This area of concern has yielded studies but it would be of interest to consider the evidence in lieu of dynamic assessment specifically as this manner of assessment is attuned to the transference of guided instruction principles. Viewing children's' ZPD and neurological predisposition as moulding to the learning situation could provide a rich source of proving or substantiating the isomorphic claim of reducibility.[52]

The idea of learning ability and its biological measurement is really not at all that new a concept! One cannot ignore the plethora of research into activity-dependent influences on the brain in which both external and self-modifying behaviour continues unabated throughout life (Smith & Katz, 1996) and neither can one casually dismiss results within the area of polygenic research (Haywood, Tzuriel & Vaught, 1992; Jensen, 1997). Dynamic assessment espouses such malleability so why not enter into reductionist research as complementary activity? Stott (1987) cites a philosopher's contemplations about intelligence thus: "the mind is what it does. Give a mind something to feed upon; give it something new to do; and it becomes a different mind" (p.217). The idea of a changing brain[53] brought about by environmentally impinging variables is starkly reminiscent of a plastic mind; a notion to be echoed a few decades later. Thus modifiability within dynamic assessment is almost perfectly attuned towards and should be quite amenable to more physiologically oriented research endeavours. The author maintains that the denial of anything emergent and contingent cannot be equated with reductionism although Gould (2004) firmly contends that in order to accept emergence from reduction it is necessary that simplified explanations at lower levels of explanation - read finer grained levels - need to be linearly additive so that one thing leads to another which leads ultimately to the whole. This, according to Gould, does not always work as explanations do not always proceed along linear lines. Historical contingency then is also a "bugbear" for reductionists, with facts accounting for much of the explanation after events but never occurring in the same way again thus making it almost impossible to form any sort of prediction of events). Scruton (2004) cautions against vulgar reductionism in which "the thing explained is identical with, reducible to, or 'nothing but' the thing that explains it" (p.29) and Sternberg (1996a) although lauding the explosion of biologically-aligned approaches towards the understanding of intelligence has issued a cautionary statement stating that it has yet to prove its link to straightforward applications in the intelligence assessment arena especially for instruction and learning outcomes. Nevertheless, the hope of seeking some sort of consilience between subject areas and methods may be in vein as is often the case when speculative areas are considered from more reductionist viewpoints. The narrowly focused jargon and area of expertise becomes so defined that the technicalities move beyond comprehension (each researcher's specific field that is) and is a view long espoused as overly simplistic especially since its modern inception in the works of Snow and Leavis (Schaffer, 1997). Suppes (2000) implies that by reductionism (at least in language) one moves towards increasing specialisation and divergence in place of the convergence (or unification of science; Bechtel, 1988) supposedly expected of this reduction exercise. Furthermore, such continuous reduction often serves no utilitarian purpose as is the case with the "reduction of computational mathematics to computability by Turing machines" (p.480) in which such reduction is irrelevant to most problems encountered in computation. But what other model is there? Ray (2001) maintains that the "core of the reductionist's faith rests on the assumption that it will always be possible to reduce all empirical statements to more basic statements with clear-cut observational consequences" (p.250). Arguing that reductionistic enterprises are the final answer to methodologies is absurd (Seager, 2001) and by leaning towards reductionism in no way implies rejection

[52] How one is to go about this exactly is another matter altogether! Consider this recommendation a matter for the future.
[53] The author unabashedly nullifies the existence of mind and equates it with brain.

of emerging properties of systems (dynamic assessment, if to be placed on a reduction-emergent continuum, would most likely be placed nearer the emergent side). But in order to grapple with issues subsumed within ever-growing areas of specialisation, reductionism offers a place to start. Cognitive developmental frameworks exist which take into account information processing models and neuroscience which aid in the integration of theories of cognition and developmental theories (Goldman-Rakic, 1986;[54] Parent, Normandeau & Larivée, 2000). Figure 3 illustrates the level at which intelligence can be described for instance depending on the type of questions asked, nature of investigation and tasks required to do so. Dynamic assessment finds itself varying between complex cognitive tasks and very complex cognitive tasks (Nęcka & Orzechowski, 2005).

Figure 3 Dynamic assessment placed in a two dimensional framework of complexity of task and time limit (Nęcka & Orzechowski, 2005, p.124)



** almost nigh impossible to test. How does one "test" for intelligence across and within life? Which tasks would be necessary to study (Lohman, 2005)? What version of intelligence theory would be utilised? Emphasis could be placed on neural speed, efficient processing of elementary tasks, biological processes and tasks successfully navigated in cultural and other environmental contexts. Bottom-up investigations are replicable but tasks are far removed from everyday reality; the converse holds for complex cognitive top-down approaches in which tasks are often beyond traditional psychometric practice and definition (Pretz & Sternberg, 2005). The question itself could well occupy many pages but suffice it to say that if complex cognitive tasks pose problems to intelligence assessment (Wenke, Frensch & Funke, 2005) there is little hope of securing answers to the former within the next few decades at least.

[54] "The pertinence of neuroscience to cognitive psychology and education is so totally direct and obvious that articulation of this relevance would seem hardly necessary" (Goldman-Rakic, 1986, p.233).

The brain is, after all, an emergent organ in the sense that global behaviour cannot be successfully predicted from the workings of specific sections within it. Yet, to properly understand the role that various areas play in this global behaviour, reducing many parts to smaller parts is deemed necessary but this is maintained only with due regard for the fact that the particulars within social systems and those of natural systems are not of the same logical type to begin with (Ryan, 1970). This issue becomes very problematic when discussions centre round social behaviour; for instance, in predicting behavioural outcomes in society at large, decision-making within economics and "laws" governing mass behaviour (often made sense of by natural science models in quite effective ways; Ball, 2005; Wilson, 1999). Reducibility as a method breaks down once systems are studied especially systems involving higher cognitive functions, especially studying within larger systems encapsulating the biological individual, the social and the cultural levels of description which are in many ways inseparable (Berry, 1996; Kriegler & Skuy, 1996; Rogoff & Chavajay, 1995).

The model of investigation is perhaps at fault and as such science as a method should be revamped or at the very least its theories of knowledge (Gergen, 1987a). There is no such model available just yet[55] (Gergen, 1987b) and so we need to proceed along the lines of working with the model that is available. A model, very much a natural science one, is a root cause of this malcontent in some circles and the rationale behind this is not difficult to understand. Wilson's (1999) dictum of consilience[56] between the seemingly dichotomised areas of natural and social science investigation pleads for a reconciliation in which a discipline such as psychology can become fused with the studies of biology, economics and social theory in order to explain human functioning (although "demonstrating examples of consilience is not equivalent to proving the unity of all knowledge" cautions Kendler, 2002, p.501). Within this mammoth task, states Wilson (1999, p.226)

> "lies the micro-to-macro problem, the ensemble of processes by which the mass of individual decisions are translated into social patterns. And beyond that, framed by a still wider scale of space and time, is the co-evolution problem, the means by which biological evolution influences culture, and the reverse. Together these domains – human nature, micro-to-macro transition, and the co-evolution of genes and culture – require the full traverse from the social sciences to psychology and thence to the brain science and genetics."

How are we to cope then in finding answers to life's problems, to intelligence assessment issues if all we have to go on is a model derived wholesale from natural science investigations? As Pauw (1993) states, when investigating natural science phenomena one does so from one level only – that of the investigator investigating the phenomena; however, social scientists have to contend with two levels of rule formation and understanding, that of the investigator and that of participant too; reminiscent of Winch's logically inconsistent triad in which the three paragons ("core concerns") of science (rationality, agency and scientific methodology) are incompatible primarily due to the "socially variable nature of rationality" (Gergen, 1987a; Turner & Roth, p.6) within the social sciences. Change at societal level will need to be instituted, changes in programmes at academic levels will need radical revamping and a new model for humanists will need to be developed. Where is this model and what does it look like? Philosophy of science has traditionally taken attempted answers and solutions to the puzzles facing natural science methodology and similarly attempted to adapt these programmes to the social sciences (Slife & Williams, 1997; Turner & Roth, 2003). That fragmentary parts of a system of social science philosophy may be found strewn across literature is evident but to date there is no successful wholesale transplant. In the meantime, what are researchers supposed to do? Hence the need to recognise the problems inherent in reductionistic studies and to conform to newer emergent views, especially within intelligence assessment. But this study has not as its aim a new model – just the adjustment of theories within the larger model as is.

2.4.5.3.6 Realist vs. relativist approaches towards research

The purpose of this study is not to detail the debate between realists and relativists within science and less so with their respective roles within psychology. However, one view that succinctly states the matter is that of Dawkins (2004) and his statements regarding the relativist problem within science. A "strand of half-baked philosophy" going by the "name of cultural relativism" (p.17) is perhaps harsh but is nonetheless considered a view towards which the author leans. Relativism has been seen by some as a viewpoint supported "by those impatient with the burden of sceptical argument" (Scruton, 2004, p.32). In essence the relativist view can be captured in this sentence: "the world as it is, and the world as it is perceived" (Harré, 1988, p.18). Relativist and critical views concerning social aspects of human life shed light on issues better dealt with from varying

[55] A suitable topic for another discussion perhaps.
[56] Originally William Whewell's term in his 1840 treatise "The philosophy of the inductive sciences, founded upon their history" (Gould, 2004; Jencks, 2000; Mautner, 2000; Whitt, 1988). Whewell's fusion of Kantian and Baconian views on the progress of science went out of favour in its own time (being heavily criticised by J.S. Mill) as it did not decree an exact line of progress nor did it acquiesce to Mill's sentiments of exact empiricism (Brody & Capaldi, 1968; Oldroyd, 1986; Turner, 1967). However a return to Whewell after Einstein's reformulation of Newtonian physics heralded a renewed look at the chances of any theory being successful, with Popper's critiques in this regard being particularly emphasised (Agassi, 1981; Brody & Capaldi, 1968; Worrall, 2002). The Newtonian and Einsteinian conceptions of gravity and space-time curvature do not evidence similar results in experiments and hence Kuhn's scientific revolution in this sense is applicable yet the two systems are mathematically similar when gravity is weak and thus physicists often work within both paradigms when the situation so necessitates (Thorne, 1995). Likewise within the social sciences can the same be said?

points of view. This is not contended as it has been often shown that certain social aspects are often explicable within the particular context in which the occurrence takes place. However, to place the progress of a science upon a relativist footing does not auger well for its progress simply due to the lack of progress that will result.[57] As Harré (2001) states, even though our knowledge of the world is not entirely independent of human concepts and constructions, the instruments which we use to measure and determine aspects do not behave in this manner unless "bolted to the world" (p.100). For instance De Jong, Bem and Schouten (2004) in similar vein, refer to an infinite regress of linear inferences (A results from B but B resulted from C and C resulted from D and so on), referring to the discordant debacles concerning the distinction of theory and data; can the two exist independently? Data needs a theory to guide perception (akin to the theory-ladeness view[58]) and theory is informed by observation and so on towards a regressive spiral or infinite regress (more of this in Chapter 3). If all is relative and observations yield to relativist inferences then a formal discipline will be unable to flourish (it simply has nothing to hold on to); perhaps the realist take on the relativist notion of "nothing real exists" should be that "nothing unreal exists" (Krauss, 1997). In its strictest form, relativism dictates that all observations are relative over cultures, times, paradigms, views, practices, standpoints and styles (McAllister, 2001). However uncontested the acceptable forms of relativism are (a hammer is a tool relative to the function it performs), issues that centre on truth or epistemological relativism are more contentious and any inferences about human behaviour within social inquiry from a relativist framework is severely criticised by objectivists (realists) (Wagner, 2003).

Science as formally practiced and endorsed by formal communities is itself a relative system of rules to be followed, a view espoused by Kuhn (Doyal & Harris, 1986). The researcher cannot escape this inevitable spiral of relativism but the spiral has to stop spiralling at some point if only to allow some vague sense of what "really" exists and how best to pursue knowledge of this alleged truthful existence of "something". Popper's falsificationist[59] rebuttal allows for science at the very least to come closer to the truth in a piecemeal fashion (Bohm, 1997; Braybrooke, 1965; Gould, 1994, 2002; Hawkins, 1997) or "stepwise nature of progress" (Gould, 2003, p.205) in which failures are necessary preludes to success. Even though the version of truth is still relative or not known (Hilderbrandt & Oliver, 2000) this falsificationist approach is perhaps too strict an approach for psychology which, as yet, is "nowhere near that 'ideal Popperian' stage of theory testing" (Meehl, 1997, p.415). However science also progresses in piecemeal fashion via the principle of instance confirmation (a principle of induction which states that the more often a theory is evidenced as being true the greater the probability of its being true, a conditional probability[60] defined by successful confirmations or not; Chalmers, 1999; Howson, 2001b). Yet as Green (1995) states, given all the data in the universe a theory is either true or not and cannot be associated with probabilities, but this is the point of inductivism, we do not posses all the data in the universe - this only rests on a probability foundation and is thus not certain (Harré, 1988). Any finite set of observations can be explained away by an infinite number of hypotheses; Silvestri and Kose (2003) and thus one is not compelled to accept the conclusion (Weyant, 1987). Popper's falsificationist progression of science does not always proceed as such within practice however and cannot thus be held up as the only criterion of scientific progress (Shadish, Houts, Gholson & Neimeyer, 1989) and it cannot be ignored that each "falsification of a conjecture is simultaneously a confirmation of an opposite conjecture" and vice versa (Gardner, 2003, p.13). Kline (1998) has stated that Popper's own theory is itself difficult to test! Knowledge, via the system of falsificationism is thus always provisional at best; a sentiment reflected in early statistical reasoning, upheld by the statistician Ronald Fisher, to be discussed in chapter 4 (Gigerenzer, Swijtink, Porter, Daston, Beatty & Krüger, 1990). This social constructionism of events and realities bodes well for more inclusive understandings of what reality is or is not and does not preclude areas of study as unscientific (Stam, 2001). Yet the social constructivists do need to offer adequate measures to remain consistent in their renderings and interpretations of constructs such as intelligence for instance (Borsboom, 2005) and educational theories (Collins, 1996). The seepage of constructivist thoughts into neuroscience also colours this field to a point where cogent arguments are offered to illegitimise such constructivist concerns stating that constructivism has failed in its long line of attempts at discrediting nativist accounts which accord the mind some power in establishing its own ideas without recourse to external interventions (Bickerton, 1997; Black & Greenough, 1997; Sporns, 1997), after all much cortical development takes place without external events evoking signals (Kennedy & Dehay, 1997).

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[57] The author is keenly aware of the fact that the framework employed in this study has relativist tinges (Madsen being influenced by Kuhn for instance) but this relativist stance within the study merely serves to place and contextualise theories within their varying histories. The black-white relativist/realist stance is obviously not as clear-cut as outlined above, and cognisance is taken of the varieties of approaches between the two poles (Capaldi & Proctor, 2000).

[58] Incidentally, Meehl (1997) refers to this issue thus "theories entail observations, not conversely"(p.393). But consider the choice of research methods and analyses which already imply and apply psychological assumptions (Ridgway, 2000). More on this in chapter 4.

[59] Gould's (1997b) lyrical notion for negative results or falsificationism is "nature's apparent silence or nonacquiescence to our expectations" (p.123). Closely related to negative findings or falsificationism is the issue of unpublished research results which confirm by way of falsification claims made or hypotheses conjectured as being true; see appendix 1 in which the "file-drawer" problem is briefly discussed.

[60] Bayesian probability is what is being referred to here; the posterior probability of an occurrence is expressed in terms of the product of the likelihood of this occurrence and the prior probability associated with it (Howson, 2001a). A finite set of probability is firstly distributed among various hypotheses after which Bayes' theorem can be applied (Brown, 2001; Gigerenzer, Swijtink, Porter, Daston, Beatty & Kruger, 1990) although this method has been criticised as being overly subjective (Percival, 2001; Salmon, 2001; Worrall, 2002), Popper maintains that it is the search for highly falsifiable or improbable hypotheses which steers science whereas Bayesian subjectivist conditional probability maintains the opposite! (Sober, 2001).

The representationalist school of test theory is one such model that constructivists adhere to when considering issues such as intelligence measurement (Borsboom, 2005). Theories of mental test scores are also verificationist-attuned not necessarily amenable to falsificationism due to the nature of their construction (see chapter 4). Realist, relativist and instrumental notions of the concept "intelligence" impinge directly on the assumptions imbedded in models of test theory and cannot be laid aside as mere speculation. If psychometric theory is to continue to adapt and acquire for itself a garb of modern progressive thought, attention needs to be turned towards the underlying philosophy of science predicating these theories (Borsboom, 2005). Realist conceptions of intelligence assume that intelligence is an identifiable construct which finds it's construct counterpart in reality via test scores; in other words it is causally relevant and Borsboom (2005) is of the opinion that latent variable theory is just such an implementation of a realist account of test theory. Borsboom (2005) asks the pertinent question of whether intelligence has to exist for theories of intelligence to exist. Answers in the affirmative attest to realist interpretations of intelligence and those answering in the negative attest to anti-realist, instrumentalist, social constructivist, empiricist and logical positivist approaches (see chapter 3 section 3.2.2 for more on the instrumentalist vs. realist accounts of science progress and thought). These philosophical "ponderings" are not merely a distraction in the pursuit of psychometric validity, but are seminal to the work being conducted in the field. Researchers including Barett (1998, 2000, 2001, 2002, 2003); Borsboom (2005) and Michell (1997, 1999, 2001, 2004, 2005) give credence and a voice to the larger issues plaguing issues of accounts of psychometrics within the philosophical realm.

Can one not tackle the issue thus with an example of colour and its perception? The colour blue might appear as purple to beings from planet Zog and reddish to beings from planet Goz and appears blue to humans on planet Earth, so then, the colour is perceived differently. However, what is being contested here is not the perception of the colour but that the colour blue can be measured at all. Blue lies at a specified wavelength on the electromagnetic spectrum (480 millimicrons[61]) and this is the case no matter who or what the perceiver is.[62] Is this notion relative? No. Do Zogians and Gozians view the 480 millimicrons in different ways? Yes perhaps.[63] Different cultures may characterise different colours in different ways due primarily to cultural and category variations, but as to whether such *a priori* characterisation affects elementary colour perception is not clear (Sacks, 1995). It is acknowledged that cultural contexts do indeed greatly influence perception, memory, inference and the way language is used (Hofstadter, 2000). Indeed some might say that cultural contexts actually construct perception and memory (Nisbett, 2003; Nuckolls, 1998) much akin to the now little credited Whorfian language hypothesis (Reber & Reber, 2001; Ross, 2004; 2005). The role of culture in thinking is testimony to how influential culture as construct can be (Altarriba, 1993; Huysamen, 1980) especially in the early years before biological maturity (Cattell, 1963) and is important when mentioned later on in this study regarding the inadequacy of Piagetian cognition and affiliated stage development, at least as this pertains to change based IRT models. We are all human beings and as such all vulnerable to more or less the same sorts of things, we see in the same way, hear in a similar manner, smell and taste in more or less equal fashions (contact lenses, enticing hotdogs and the sounds of the Beatles would not attract so many people if the case were otherwise). Are these sensations relative? Perhaps to prehistoric man, the Beatles might come across as a cacophony of notes, yes; it is conceded that this is indeed relative. But its relativism is predicated on the fact that we all hear. This cannot be doubted. All ears hear. Is this disputed? Can reality then not be predicated on a similar argument of the fact that we can all observe? Yes, but we may observe "different" things, *but we observe* and it is this predicate to which reference is made when considering that science should be construed as realistic and not relativistic. The devil is in the details one might add, and as such these minor issues cannot be ignored by the realists. Meehl (1986, p.322) states in this regard "there is no reason for us to have a phobia about the word 'truth'. The idea that you shouldn't ask whether a scientific statement is true, separate from the anthropologist's or the Hogo Bogo's belief in it, because you can't be absolutely certain, is a dumb argument".

After all social constructionist and critical movements do not necessarily have as their antithesis notions of anti-realism (Stam, 2001) as both positions can be accommodated but the point at which agreement must be reached is often problematic. Evidential weight attributed to empirical findings differs across studies, times and locations. However, the fact that so many innovations surround humankind attests to this formal method's (science) hierarchical progression from worse to better explanations and understandings of how things work (Mouton, 1993b) even though "science" itself may be construed as yet another religion (Slife & Williams, 1997; Wagner, 2003) or system of knowledge ("a sociological phenomena open to manipulation by power structures"; Brand, 1998, p.66) or "style" of insight and discovery (Gould, 2001b). It is no better than any

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[61] Reber and Reber (2001); Sternheim and Kane (1991).
[62] Dennett (1993) dismisses this line of argument and refers to it as not only elementary but false. This line of argument rests on the nature of the reflectant surface thus altering the light as perceived by ourselves. But once this path is trodden upon, the author contends that the relativist argument is invoked much to her displeasure as it is now known that this type of spiralling argument is solipsistic.
[63] Colour construction by the brain can be approached in a top-down manner and although it holds sway as relativist counterargument, it cannot logically argue against the overwhelming influence of the bottom-up approach which evidences that colour need not be influenced by socially constructed knowledge at all and in some cases of colour blindness, colour can be generated by magnetic stimulation of certain cells (known as V4 cells which are specialised for responding to colour) (Sacks, 1995). So is colour constructed? Yes and no. Perceived colour may be relative but its existence as vibrating wavelength is most certainly not. Unless of course 480 millimicrons comes across as green in another dimension evidencing altered laws of physics. But the argument should rest here for the time being.

other method (Chalmers, 1999; Wilson, 1999), even an ideology of sorts (Shames, 1987a). The method is not to blame nor the knowledge that science produces but it is society that decides upon the use of that knowledge (Dennis, 1997). "I take it that the scientific method, of which so much has been heard is hardly more than the native method of solving problems, a little clarified from prejudice and a little cultivated by training" (Lewis, 1959, p.87) is yet another informal definition of what it means to practice the "art", to which Lewis adds as an aside that measurement yet be a tool only for science and not to be defined as science itself, an aspect to take note of. This aspect of construing techniques as tools is relevant to the techniques and models employed within statistics where tools are not theories but instruments to these theories (De Leeuw, 1994). Weekly peer-reviewed journal articles posit findings and discoveries and follow "forward" moving trajectories in the sense of gathering more data to either support or refute hypotheses (although subversives have often cited instances in which the "progress of science" such as it is, really is quite arbitrary and is a view now commonly referred to as the "science wars"; Hertz, 2002; Nelkin, 2000; Radick, 2005; Segerstråle, 2001). The rebuttal to this is that the very core of this process is itself fraught with inconsistencies, biased reviewers, political interference and of course dictated in large by those with power and wealth.[64] It is at times considered mere institutionalised attitudinal beliefs (Brown, 2001b, 2001c; Campbell, 1986; Cornwell, 2004; Jungk, 1960; Nester, 1996; Pestre, 1997; Shames, 1987a; Stevenson, 2000) and is tinged with a critical psychology colouring of what it means to engage in scientific research, knowledge for beneficence or exploitation[65] (Austin & Prilleltensky, 2001; Fox, 2000; Sampson, 2000)? The social constructionism of mathematics and statistics has also been an issue of concern (Ernest, 1998; Hughes, 2000), an area which would seem least vulnerable to relativistic leanings but is of concern as both these foundational subject areas of are of prime concern to this study. Specifically with regard to measurement in psychology, Michell (2000) boldly states that in order for psychology to be given credence for its formalist stance as science, measurement was deemed necessary for political reasons. It was necessary in order for it be given admission to the scientific community and to benefit directly and indirectly from its commercial success as quantitative (see chapter 4). Scientific proofs[66] cannot be deduced from logical calculus alone as science (as has been shown by critical psychology) is value-laden (Mouton, 1993b) and intuition is often the "given" as staring point within logical argumentation, a given being a primitive which rests on its own assumptions as being unequivocal (Kukla, 2001). An argument, which Wittgenstein employed by maintaining that human perception would never be replicated within a formal rule-based system because any factual statement about the world would need to be derived from another factual statement and so on *ad infinitum*, hence there were no primitives as such that could serve as a foundation for cognition (Horgan, 2000). One has to start somewhere and failing to locate a starting point leads down a path of never-ending regress. Yet, this naïve folk psychology idea of a given, an understanding itself has run the gauntlet of expedient explanation; and "folk psychology has already been pushed way beyond its limit"(Wilson, 1999, p.223). The issues surrounding primitives or axioms are discussed in chapter 4. How is one to evaluate the "self-evidence" of a primitive postulate if it is impossible to prove such a primitive? (Hempel, 1983). The intuitive grasp for primitives is one point of departure within the constructivist school of foundational mathematics which will be discussed in chapter 4.

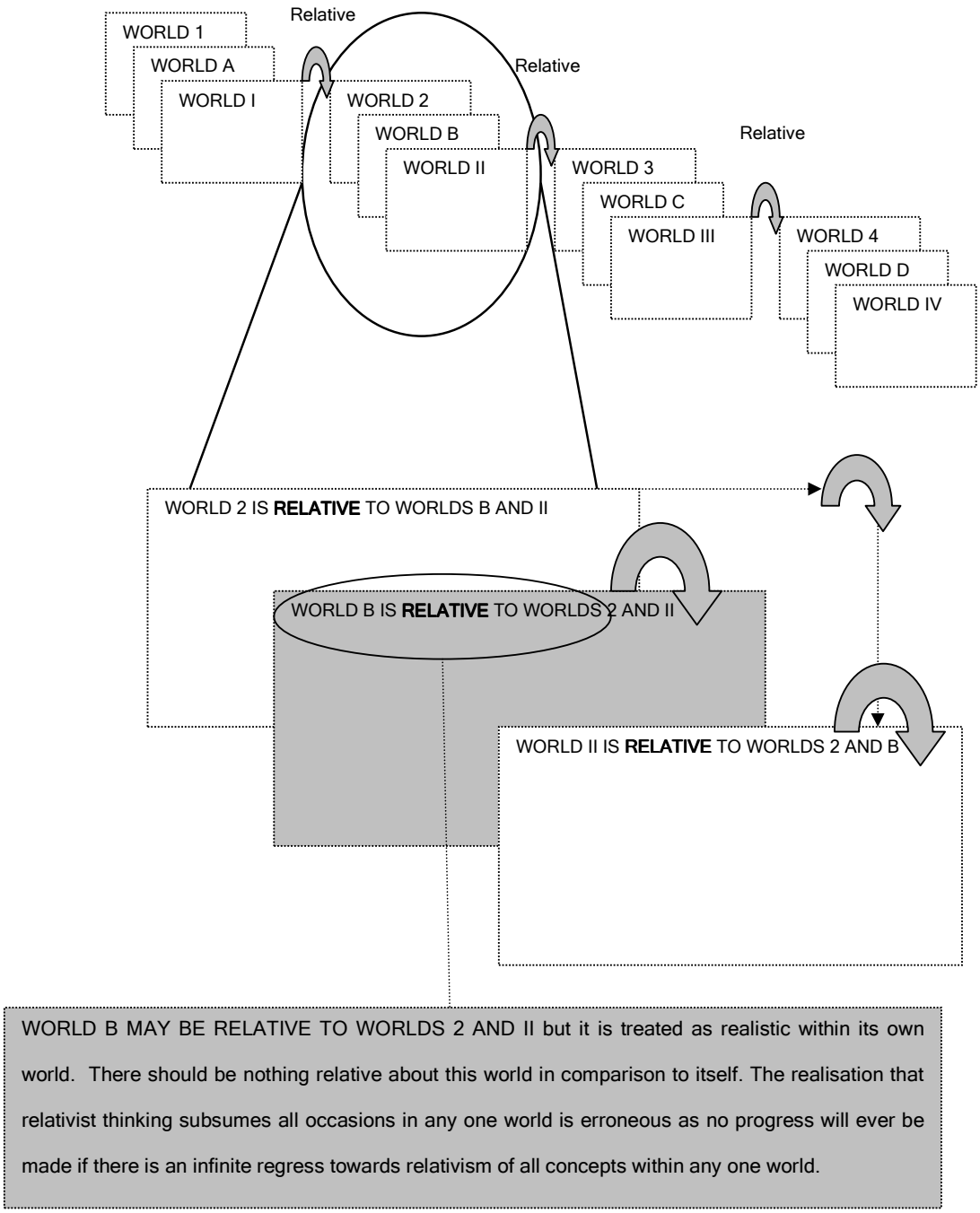
Relativists do not question empirical research because they fear that inferences are not "true" but because the conclusions are not final (and never can be if one is to extrapolate this argument to its fullest, for all times and places). Axioms would thus find no place within this philosophy as even accepted predicates are not objectively true but this is not to say that relativists are anti-realist in the sense of not acknowledging unobservables (Achinstein, 2001) as it is their interpretation that differs. Relativism has been construed as an edifice of policy that is mounted when moral and political issues are germane to a topic at hand and not as a logical issue as forms part of the traditional philosophy of science (Harding, 2001). That the philosophy of science is relativist in the first place is where the spiral starts to spin out of control. After all the relativist's stance is relative too surely? Hence, his relativism is absolute and that, according to relativist premises, is not possible (leading to logical contradictions within the system) (Mautner, 2000; Robinson & Groves, 1999; Scruton, 2004), to which the realist may well reply "can we get on with it please?" In relation to the nature/nurture debate which follows next, Wilson (1999) contends that cultural relativism, in a manner of speaking, was able to rescue legitimate biological-basis-of-behaviour theories (by dragging misconstrued social Darwinism out of the mud) into a respectable area of study but only at the cost of "turning against the idea of a unified human nature grounded in heredity" (p.204).

The author has no legitimate gripe with the fact that issues are relative in their broadest sense, however, the argument rests: the realist take on science might not ultimately[67] be the best philosophical stance to endorse, but it's as close as we are going to get

[64] Part Five of the edited volume by Gholson, Shadish, Neimeyer and Houts (1989) deals specifically with the social factors involved in the psychology of science.
[65] An issue (like others contained elsewhere in this section) which has particular significance for intelligence assessment and dynamic assessment. Are practitioners needed to classify or assist? What has become of our aspirations to aid in the development and growth of individuals if classification is always the end result? More pertinent to the intelligence assessment issue is what happens when science and social policy collide; more often than not science has to bow to political agendas when all scientists know that this should not be the case (Brown, 1994).
[66] In the strictest and purest form of mathematics however, nothing can be substituted for proofs in the establishment of truths not even correspondences with reality (Jaffe & Quinn, 1993). Proof in mathematics is analogous to the experiment in the natural sciences; a manner and method of knowing the truth (Butterworth, 2000).
[67] The author uses the word "ultimately"" as it is only with the passage of time that these and related issues might be further resolved.

to one. It is imperative that a position is taken on such an issue (Wagner, 2003) whilst acknowledging the inherent disadvantages within such a chosen approach. Critical psychology's initial reaction to positivist science as originally engaged in the early twentieth century in terms of maintaining the status quo (keeping the marginalized at bay by further supporting the need to do so through scientific research) is acknowledged as such (Snyman, 1993) and its relativist leanings are accounted for by reactions to the ways in which science was practiced. Critical psychology per se reflects no one specific area of investigation, it being an approach towards studies which seek either knowingly or unknowingly to continue to adhere towards discriminatory practises (Nightingale & Neilands, 1997; Prilleltensky & Fox, 1997; Richardson & Fowers, 1997) and in a way, this study's guiding light really is dynamic assessment's philosophy and stance regarding human intelligence and growth with which the author shares a close affinity. Cernovsky (1997) makes explicit his regard towards intelligence assessment relating to this issue. Perhaps a more apt (yet less circumlocutory) title would have included "critical" alongside "exploration". And it is upon *this premise* and general notion that support for this author's opinions is given. A radical relativist might well throw in the towel round about here. An illustration might serve to illuminate this stance on the relativism/realism debate in figure 4 below.

Figure 4 Relativism and realism between and within worlds



2.4.5.3.7 Perennial nature/nurture

Thankfully the debate (or showdown) between nature-nurture[68] supporters no longer represents the stark and opposing views on the matter as once was the norm (Fischer, 1980; Plomin, 1989, 1997; Rose, 2000). The reconciliation now assumes a more or less substantial portion of both contributions to the end-product of human behaviour including cognition (Klivington, 1986; Plomin & Petrill, 1997; Sternberg & Grigorenko, 1997) resulting in the more-or-less uncontested notion of epigenetic (genetic/environmental) rules through which much of human behaviour is guided (Greenough, Black & Wallace, 1994; Wilson, 1999). Nature or nurture has become nature and nurture; nurture through nature and even nature through nurture (Lloyd, 1995). Yet the idea of transfixed intelligence levels presumed unalterable (yet malleable to a degree via home environment and mediated by latent processes eliciting both continuous and discontinuous development) and predictive of later ability is still pervasive in lieu of many studies'evidence (Cardon & Fulker, 1991) which attest to the limit of environmental factors resulting in the malleability of IQ (Locurto, 1991). Yet, both environmental and native contributions are inherently constraining in how development progresses as certain biases exist both internally (neuronally) and externally (environmentally) (Johnson, Bates, Elman, Karmiloff-Smith & Plunkett, 1997). The oxymoronic situation of nature's hard wiredness and the brain's neuronal[69] or synaptic plasticity (Squire, 1986; Von der Malsburg, 1987) poses an irony of sorts but when cognisance is taken of both phenotype and genotype influences on the developing organism it can be seen that hard wiredness and plasticity co-occur; an aspect grounded within dynamic assessment. The study of gene-environment interaction pivots the notion of gene sensitivity to environmental effects, in other words how the environment moderates genetic effects (Asbury, Wachs & Plomin, 2005). However this debate takes on a decidedly more subdued veneer when subsumed within intelligence assessment and race issues (Gordon & Lemons, 1997; Valencia & Suzuki, 2001). That debates no longer ensue per se between these two seemingly opposing views is not a true sentiment, as the focus has now shifted onto the quantifiable differences between the two such as the contribution between both between-groups and within-groups differences in intelligence (Suzuki & Valencia, 1997). As Rose (2000) fervently states, this debate "has been the preoccupation of what we may call 'Anglo-Saxon' psychometrics" (p.123).[70] There is renewed concern for how the two views accommodate the nature of phenotypical change as opposed to how much each view contributes to change (Ceci, Rosenblum, De Bruyn & Lee, 1997).[71] The enveloping framework which grounds this debate is contested though as misleading in terms of presenting the two as opposing views on a continuum. The new framework as informed from insights obtained from molecular genetics and developmental biology illustrate the epigenetic view of these two complementary viewpoints (Bidell & Fischer, 1997). As Piaget originally wrote in 1971 and in agreement with biologist C.H. Waddington, predetermined genetic unfolding is simply not the manner in which development proceeds and he calls for envisioning development as emanating from a set of axioms which when fully developed cannot be derived from the axioms originally underlying it (Piaget, 1994).

At this point in time it can be stated that the author's leanings are towards a more-or-less equal contribution made by both nature and nurture but the following statement is firmly supported: at the very start there is biology[72] ("psychology is inevitably based in biology"; McManus & Bryden, 1994 just as "mind had to be first about the body, or it could not have been; Damasio, 2006, p.xxvi) and it is common knowledge that single-gene disorders are identifiable as particular areas on chromosomes even though it is conceded that linking intelligence to genes is not as straightforward an issue (Plomin & Petrill, 1997). However, findings within mental-retardation research and Alzheimer's have evidenced single-gene linkages. Other single-gene linkages include phenylketonuria which results from the carry over of a single recessive gene from both parents (Plomin, 1997) yet the effects of this mutation can be nullified by the correct dosage of phenylalanine (hence the environmental effects on phenotype expression) (Sternberg, Grigorenko & Kidd, 2005). Genetic markers are of late starting to emerge in the molecular genetics field related specifically to intelligence and there is good reason to believe, at least for now, that this area of nascent research can only but add value to the field of intelligence and dynamic assessments of ability and potential (Petrill, 2005). It is conceded that pleitropic (and even probabilistic) interactions make up the varied synchrony of manifest behaviour and intelligence functioning. The accepted form of genotypical influence on phenotype arises as a result of group genetic influences (Wahlsten & Gottlieb, 1997)

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[68] Or phylogeny and ontogeny - this plays forth in a later section dealing with the heritability of intelligence (*h*).
[69] Considered the brain's computational unit which can grow or deplete in neurogenesis-inducing tasks (Bolhuis, 1997; Innocenti; 1997).
[70] Of course the fact that this is even considered an issue here is perhaps more telling of the author than the subject at hand!
[71] Although Hunt (1997b) does make a point when he states that this debate represents one of those acrimonious areas in psychological research where "if you missed it the first time, you can always watch the reruns" (p.531).
[72] Critics might well add that biology itself is a product of continual environmental input and that our very DNA is a result of parasitism (Zimmer, 2003) and that viewing the genome as a code or programme is limiting in terms of its not accounting for developmental branchings that govern gene activity (Oyama, 1994). How far back this argument can go is without a doubt thought-provoking. But the "environmental" influences referred to within this study are those that are least variable in terms of genotype alteration within a single human being within a single life-time. Of course there is evidence that phenotypical changes can in fact alter genotype within an individual in a life-time (Meng, Smith, Hager, Held, Liu, Olson, Penington, DeFries, Gelernter, O'Reilly-Pol, Somlo, Skudlarski, Shaywitz, Shaywitz, Marchione, Wang, Paramasivam, LoTurco, Page & Gruen, 2005; Phillips, 2005; Scott & Louis, 2005; Weaver, Cervoni, Champagne, D'Alessio, Sharma, Seckl, Dymov, Szyf, & Meaney, 2004). It is cautioned that intelligence itself is a phenotype, with at least half the variance of IQ being explained by non-genetic factors (Plomin & Petrill, 1997). Namely environmental impingements working via both experience-expectant (akin to the critical periods of development, say for language acquisition) and experience-dependent processes (Black & Greenough, 1997).

and the relation to high and low psychometric IQ has already been linked to variant allelic associations or frequency for two genetic markers (Ceci, Rosenblum, De Bruyn & Lee, 1997). It is becoming increasingly obvious for the need to view intelligence measurement from biological-environmental models as opposed to solely envisioning intelligence from psychometric perspectives only (recall that psychometric results are biological derivatives obtained from different manners of assessing for essentially the same purported construct; Sternberg, 1991). Depending on how studies are conducted and the measures utilised in the process of deducing what in fact contributes more towards intelligent behaviour, will often affect the final result reflecting a situation in which studies convinced of either the role of nature or nurture as superseding the other will often come to an expected conclusion (Scarr, 1997). Central to this nature/nurture debate concerning intelligence is the degree of brain plasticity and how environmental impingements on the brain often result in neuronal changes (both arborisation and pruning or the constraining of neural plasticity) (Johnson, 1994b; Kolb, 1994; Kozorovitskiy, Gross, Kopil, Battaglia, McBreen, Stranahan, & Gould, 2005; Nowakowski, 1994; Scheibel, 1997). The extent to which these changes remain permanent and are transferable (typically the goal within any dynamic assessment intervention) is contentious (Das, Naglieri & Kirby, 1994) especially as it pertains to development and learning[73] as well as task familiarity and task similarity (DeFrance, Hymel, Degioanni, Calkin, Estes, Schweitzer & Hymel, 1994; Greenough, Black & Wallace, 1994; Huttenlocher, 1994; Klauer & Phye, 1994).[74] Transfer of skill and modified cognition is dependent on the nature of intervention which can range from standardised prompting to intensive mediation (Delclos, Vye, Burns, Bransford & Hasselbring, 1992) but this is of course where the choice of intervention becomes problematic in terms of feasibility. Intervention work within intelligence often assumes plasticity of intelligence in contradistinction to mainstream thoughts (Gulgoz & Kagitcibasi, 2004).

The current literature on domain-specificity and domain-generality within assessment has brought to the fore the question of what exactly is being tested for and changed as a result of intervention. It has been argued that specificities of cognitive skills can be construed as less *g*-loaded than generalities (overall skill) which emerge when the totality of specificities is factored into a primary *g*-loaded factor for instance (te Nijenhuis, Van Vianen & Van der Flier, 2005). Are neuronal changes within the plastic brain brought about when cognitive interventions seek to induce behavioural change? These changes are often verified on a behavioural level (cognitive mental construct level) but not necessarily within a deeper neuronal level (cognitive neuroscience level) within dynamic assessment research. Nevertheless, should change occur at many levels of description, the remaining issue is whether what was changed will remain stable and enduring and how this change impinges back on to *g*-loaded constructs. This entire argument of course hinges on the assumption that *g* as an entity (statistical artefact or actual "thing" in the brain[75]) exists (Lohman, 1997b). Psychometrics pleads for statistical artefacts to aid in explaining away findings on assessment instruments. Dynamic assessment pleads for behavioural change to explain away findings on assessment instruments. Are these varied approaches talking at cross-purposes? Nature vs. nurture, static vs. dynamic assessment, reification of statistical artefacts vs. identifiable mapping of such a construct within the brain are all issues which factor into the area of dynamic assessment within intelligence. These issues are not near to being resolved, but perhaps if these issues are considered as central some progress might well be achieved.

2.4.5.3.8 Static vs. dynamic assessment of intelligence and potential

Although this issue is mentioned as a separate heading it is placed here for the express purpose of allowing for the immediate seepage of thoughts and alignments which have been expressed above to filter through and thus permeate the issues highlighted below. The stance on dynamic assessment and static assessment within intelligence research, which this author takes, can now be better understood in lieu of the varying views thus far expressed (mind-brain, consciousness etc). This study seeks to explore a meta-theoretical framework for dynamic assessment and intelligence and in order to accommodate the many types of assessments to be had, practitioners would do well to take cognisance of the advantages that each has to offer the field of intelligence research. Dynamic assessment has never sought to overthrow nor do away with conventional testing (for which at times it is a firm supporter). Dynamic assessment follows a progressive and accommodating mandate which aligns itself with more static type intelligence assessments often serving in a complementary fashion. It redirects the attention of practitioner and researcher to the potentially rich source of variation to be found in many types of intelligence assessment protocols. The fact that this study exists is testament to the firm belief the author has in the potential that dynamic assessment has to offer but is simultaneously fully aware of the need to maintain and develop more static types of assessments. Both are equally necessary. Dynamic assessment is entangled in messy ontological, epistemological and foundational philosophical issues:

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[73] The actual relation between developmental changes and their concomitant neural changes in terms of volume of axons and dendrites has not been adequately addressed (Huttenlocher, 1994) but that there is a decidedly direct link is clear (Horn, 1994).
[74] Neurogenesis has, in the past, been supposed to have resulted from enriched and stimulating environments. But even this "fact" is being reconsidered in light of new evidence against this hypothesis (Meshi, Drew, Saxe, Ansorge, David, Santarelli, Malapani, Moore & Hen, 2006).
[75] Spearman's *g* factor as statistical artefact as opposed to the later idea of the speed of neuronal firing being equivalent to *g* as expressed by Eysenck and his colleagues (Eysenck, 1987).

- firstly it is located within psychology, which itself as a discipline hovers continually between a natural science styled endeavour to understand human beings as opposed to the more relativist and grounded understanding emanating from ethnographic discourses;
- secondly, it has developed alongside a seemingly opposed manner of assessment, namely, psychometric assessment which often concerns itself with the assessment of intelligence. Yet it can even be stated that dynamic assessment has done a service for mainstream assessment in broadening the view encompassed by psychometrics instead of ousting it and has not yet evidenced a dislodgment from psychometrics to date (Kozulin, 2005)
- thirdly, the field of intelligence research is so overwhelmingly well padded with empirical research data that the very construct of intelligence is still not definable
- fourthly, its history is one of amalgamation of European and American thought, often represented by very different views on human nature (rationalist philosophical bents versus more pragmatic empirical bents; Smith & Katz, 1996)
- fifthly, in trying to balance views and attend to various opposing philosophical stances on human behaviour and assessment it would seem that dynamic assessment is stretching itself rather too thinly, for in trying to please as many views as possible it has become hybridised in order to merely survive as a method of assessment. At once firmly advocating its primary tasks as method of assisting change in human thought through the process of assessment and advocating its staunch strictly science-like approach towards this same endeavour. Can dynamic assessment have its cake and eat it too? Perhaps, but in order for this to be realisable, its ensconced foundations need to be studied

At times, problems seem insoluble and intractable so much so that any path evidencing light at the end of a very un-illuminated tunnel seems almost to good to be true and any viable solution on the horizon is immediately investigated for possible avenues of pursuit. That this study is one such viable option can only be later assessed. Dynamic assessment offers a powerful humanising approach towards assessment;

- It is a method which seeks to humanise the research subject, a subject with cognitive as well as affective characteristics;
- It is an ecologically valid approach towards assessment which aims to be an unbiased, culturally relevant, clinically orientated, time-consuming enterprise in helping individuals achieve change in all its enlightened connotations,
- It was an early flourish and confluence of French, Russian and Jewish psychology later stirred up with American and German standardised empirical research and practice but always having as a goal, change, within assessment, acting as catalyst of growth within a context of examiner-examinee interaction

The estrangement of such obviously opposing views on how science should be practiced cannot be more firmly illustrated than by viewing this history of dynamic assessment. Dynamic assessment appears almost ethnographic in mode utilising a critical psychology approach towards the treatment of individuals, modes that are in complete dissentience to those more attuned to objective explications of individuals. Theirs makes for an uneasy alliance. Yet, such opposing and dichotomous views permeate and at times define what it means to engage in dynamic assessment within psychology. No wonder this field is at a crossroads, for it can be stated that psychology finds itself stranded at a similar junction unable to move. Insoluble and intractable? Or are we in fact asking the wrong questions?

2.5 Summary

The reasons why the above-mentioned aspects of human investigation were chosen for brief discussion (over-and-above those already stated) is the intertwined nature of each aspect's basic epistemology and how this filters out in how research is conducted (Wagner, 2003). Each aspect and its requisite beliefs held by the author influence and impinge on the other. To advocate that mind is brain or that consciousness is bundled nerve fibres and to concurrently maintain that intelligence is not similarly reducible makes for an uneasy and unworkable framework within which to work. Is it possible that, at once, a belief in such contradistinct issues can be held? That times change and along with it technology and understanding of how things work is a given, and although the author has stated her basic epistemological and ontological leanings, it is not to say that such leanings will forever be held static. For now, as the case rests and for what is to follow (however much or however little these leanings weave their way into the study) these affiliations are considered stable and enduring. As stated above in 2.4 the sorting out of philosophical issues at the outset is just as necessary a task for the author as it is for the field of dynamic assessment. The author is merely reflecting a trend necessitated by the field.

It may seem from what has transpired above, that the author is a firm believer in what is considered in some circles to be quite unseemly and old-fashioned. The irony of the situation is just this: although in support of reductionism, leanings towards hereditarian views and beliefs in a more general intelligence and all that goes with these beliefs as well as realist interpretations of reality as opposed to the relativist counterparts, there lies a firm conviction and intuition that change occurs throughout life, that emergent properties of systems loom below the surface and if tweaked will blossom and that no-one is a victim of their biographies. It is for this very reason that the ensconcement of dynamic assessment within intelligence assessment in psychology is at its very axiomatised core a belief system which (an *a priori* system, struggling towards *a posteriori* distinctiveness) if given the right opportunities and correct advancements, will surely date conventional approaches towards

human intelligence assessment and replace the current edifice or core affiliations with a more informed, progressive, utilitarian and enlightened foundation.

No pangs of guilt are evident when acknowledging that in order to better understand the workings of humans in all their varied contexts, reducing each area of study is the better method to follow. There are countless arguments and debates concerning the validity of the scientific method itself, but the belief in this method's superiority in comparison with other advocated methods is up-held.[76] is it *the* best method per se? Probably not if one was to study all possible methods through all possible times and all possible places in time but the point is that we are not allowed such luxuries and hence need to conform to one tried and tested method which does have an enviable record in getting things right (despite all the misgivings of those who deny this and also despite the method's unfortunate histories within varying contexts – no method is perfect after all). In similar vein, relativism is an admirable undertaking when considering all possibilities of investigation and a critical approach to how things are studied and for what reasons aids in keeping the enterprise on its toes but that all approaches need to be accommodated, through all time and all locations threatens to unravel a method which has thus far proven helpful.[77] It is felt that it is fairer and safer to lay the cards on the table even though to have made choices between supposed dichotomies might in some circles be considered ill-conceived.

Choices do need to be made. One cannot forever dance in the middle accepting all views all the time. Some views are less extreme than others, granted, but it seems unlikely that the very human enterprise of seeking new knowledge will get anywhere without choices being made on fundamental issues.[78] Attention is now turned to dynamic assessment proper with a brief introduction to this manner of assessment which encompasses a glance at its historical growth as well as a brief look at who is considered by some to be the father of dynamic assessment; Lev Vygotsky and his role within the Soviet psychological enterprise. This section will conclude with a look at the current awareness of this method in the United States and the United Kingdom.

2.6 Dynamic assessment within intelligence

The aim of this theoretical study is to devise for dynamic assessment a framework which will provide a means for comparison of various models and theories within dynamic assessment as housed within the broader field of intelligence assessment. The framework developed for this purpose is the culmination of concerns spanning basic philosophy of social science research, the methodology of science and social science as product of the times, meta-concerns in terms of the general direction of advancing science practice and specifically issues pertaining to psychometrics; mathematical, statistical and measurement foundations of psychological assessment. Advances within psychology in general but more specifically within assessment have more often than not been steered in various directions according to agendas, whether implicit or explicit and have resulted in the position in which current intelligence research and dynamic assessment find themselves. Likewise, it is to be expected that the framework for this study has been similarly affected by historical contingency and it too will most likely be accepted as a product emanating from a time in which the concerns looked at were to be expected. The application and exploration of a meta-theoretical framework will be discussed in chapter 5. For the purposes of clarity, the general introduction to dynamic assessment and intelligence will be placed here due to the many comments which will be made in the following chapters which in turn will necessitate familiarity with both dynamic assessment and intelligence.

2.7 Dynamic assessment: fundamentals

Dynamic assessment is a manner of assessing individuals' at times hidden potential (reserve capacity) in a fluid, process-orientated, diagnostic, engaged and flexible manner in which aiding or guidance (via instruction and feedback) of cognitive skill acquisition is of prime importance (Campbell & Carlson, 1995; Elliott, 2003; Gillam & McFadden, 1994; Grigorenko & Sternberg, 1998; Kirkwood, Weiler, Bernstein, Forbes & Waber, 2001; Kirschenbaum, 1998; Kliegl, Smith & Baltes, 1989; Lidz, 1991, Lidz, 1997; Meyers, 1987; Minick, 1987; Sternberg & Grigorenko, 2002). It stands in stark contrast to the more product-bound approaches of mainstream psychometric and edumetric assessment (Craig, 1991; Gupta & Coxhead, 1988b; Resing, 1993; Slenders & Resing, 1997) by emphasising the change in performance (rate) and remedial strategies necessary to progress (Bejar, 1984; Brown & French, 1979; Campione, 1989; Wiedl, 2003). Rate of learning, amount of improvement (typical of the

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[76] Although the author is in agreement with Faust and Meehl who state that "Knowing that science is the best game going and has produced remarkable achievements establishes little about its approximation to the optimal" (1992, p.201) one is left with the question of what is optimal? There is no benchmark really for this concept.
[77] In more instances than not it has proved helpful - although this will undoubtedly be debated.
[78] Who is to say that the enterprise of science itself is not just one more method of viewing life? Yes, this is accepted. However, to carry on in this manner will inevitably lead nowhere. One has to know when to say "stop" and proceed from a foundation as solid as can be made. Intelligence is a relative concept, to measure it is relative, to even consider it as a concept is relative. One feels uneasy with this type of argument as it becomes evident that to even try to explain or measure or assess it seems to be a futile endeavour. One might as well give up.That intelligence has been understood in terms not amenable to all views is acknowledged. This, however, does not necessitate giving up on trying other ways of explaining it and related concepts.

Feuersteinian and neo-Vygotskian views) as well as amount of aid necessitated (more modern views of gauging potential) are all methods of assessing for growth of learning or potential (Ferrara, Brown & Campione, 1986). The relationship between tester and testee as characteristic of strict neutrality is the hallmark of conventional testing which, if violated, would render the objectivity null and void (Greenfield, 1997) but not so with dynamic assessment (Lidz, 1992b). It represents greater all round diversity in assessment and the method's results extrapolate to a far wider field of application than mainstream assessment (Gupta & Coxhead, 1988a) leading to, at times, fairer and greater predictive diagnostic validity (Ferrara, Brown & Campione, 1986; Gredler, 1988; Resing, 1997) for below-average performers (both majority and minority groupings) on conventional IQ tests (Babad & Budoff, 1974; Budoff & Hamilton, 1976; Hessels, 1996). Movements are afoot within static-based modes of testing which seek to make such tests more functional, at least for special education populations in terms of prescribing treatment in respect of test results yielding another type of validity, that of treatment validity (Flanagan, Andrews & Genshaft, 1997).

The nature of instruction and feedback is not one of repetitious aid but of engaged understanding of the unique attributes of the individual being assessed (although this can vary dramatically depending on reigning circumstances) (Goikoetxea & Gondra, 1995) where the learner is a participant and not a subject in the active learning process (Svinicki, 1998). The relation can even be said to be one of personal understanding (Feuerstein, 1972). Synonymous terms with very similar philosophical backgrounds resonate with this method of assessing learning potential and include among others, learning tests (or the German lerntest), interactive assessment, trainability testing, testing-the-limits (via graduated prompting) and mediated learning (Brown, Campione, Webber & McGilly, 1993; Fernandez-Ballesteros & Calero, 2000; Swanson, 1995; Von Hirschfeld & Downs, 1992). It can be viewed as a strategy within the cognitive education approach where educability is understood to be synonymous with the modification of intelligence (Chartier, 1996). The basic rationale behind the method of assessment is that if a student can improve upon initial performance when aided (hence interactive; Lidz, 1991), resident potential exists with which much can be achieved[79] (Ukrainetz, Harpell, Walsh & Coyle, 2000). Testing-the-limits allows for the pre-establishment of an age-appropriate level of achievement according to which children are assessed via a step by step process of approximating the maximum levels of performance (Kliegl, Smith & Baltes, 1989). Depending on the level achieved for any one group, individual differences within the group can be assessed thus allowing for more accurate assessments of development level (De Ribaupierre, 1993).

Inherent contradictions pervade the mainstream assessment field especially within educational contexts (where dynamic assessment sits at ease; Daniel, 1997). In such circumstances, current functioning is utilised as indicator of future success (Kozulin & Garb, 2002) where in fact the learning process itself should be utilised; it is after all the goal of education to monitor the *learning process*. By observing change and by directly interfering with development one is more able to understand this process (Paour & Soavi, 1992). Learning and instruction as well as assessment and teaching are examples of dyadic approaches utilised in models encompassing Feuerstein's original notion of instrumental enrichment where there is a dual process carried out by both teacher and student as well as the processes of information gathering. One need only think, for instance, of Ashman's Process-Based Instruction (PBI) model (Ashman, 1992). Feuerstein's product is an applied instance of dynamic assessment more so than a separate theory of dynamic assessment (Feuerstein, 1994) where intellectual potential is "activated" via instrumental enrichment (an instance or interrelation of his theory of cognitive modifiability) (Lidz, 1992b; Messerer, Hunt, Meyers & Lemer, 1984). The acceleration of maturation through learning is an old Vygotskian notion (Das, Parilla & Papadopoulos, 2000) which seems to be rediscovered every so often in one guise or another. The emphasis within core dynamic assessment interventions is placed simultaneously on learning potential as evidenced through cognitive skill which is in turn founded on psychological-cognitive theory (Guthke & Beckmann, 2000a). Here the link between dynamic assessment, cognition and intelligence comes to the fore. Dynamic assessment is so widely applicable in so many contexts that relegating it within the intelligence realm only is short-sighted but this is the focus of this particular thesis. Common characteristics include (Carlson, 1994):

- The notion of inherent modifiability
- Competence and performance which are two divergent concepts
- Test performance as enhanced via interactive intervention
- Process which is paramount to product and
- Development of abilities which are better or at least complementary to developed abilities

Some researchers who do rely heavily on static based conceptions of intelligence yet render this dynamic, prefer a reference to intelligence as "cognitive activities" in order to reflect the process-based nature of intelligence (Carlson & Wiedl, 2000). The teacher or tester is a reflective person who not only monitors the individual being tested but engages in a process of self reflection, judgment and control (Reichenberg & Rand, 2000). Four general aspects which can be considered as characteristic of this approach include its tester-testee relationship which is newly defined as one of collaboration and sharing (S. Feuerstein,

[79] Of course there exist populations for which even extensive interventions have little effect.

2000); the process vs. product manner of assessment; the nature of the test and the various tests utilised and the manner in which the results are interpreted (Tzuriel & Klein, 1987). Teacher perceptions have been shown to change after dynamic assessment interventions are conducted, resulting in changed expectations of performer and performance (usually for the better) (Benjamin & Lymofsky, 2002; Bransford, Delclos, Vye, Burns & Hasselbring, 1987; Delclos, Burns & Kulewicz, 1987). The link between assessment and intervention as well as the link between assessment and environment and the nature of the process and product of behaviour are noteworthy characteristics of this approach (Meyers, 1987). The learning process is at the core of this manner of assessment and can be studied and observed in the actual learning situation through the analysis of learning curves as well as via the presentation of a learning or training phase during the pre-testing phase of a pre-posttest set-up (Hamers & Sijtsma, 1995). Both pre-testing as well as the monitoring of the learning process itself are necessitated if adequate intervention strategies are to be planned as advocated over seventy years ago by Vygotsky (Day, Engelhardt, Maxwell & Bolig, 1997). This is consistent with his notion of ZPD – how else is one to know of future growth if present rates are not known? Dynamic assessment overflows the boundaries between intelligence (typically the ability to solve unfamiliar problems in the environment) and achievement (the ability to extract and assimilate information within the cultural environment including the schooling system) (Cahan & Noyman 2001). Losardo and Notari-Syverson (2001) offer a generic "theoretical framework" the use of which some may question, and state that dynamic assessment encompasses six theoretical assumptions:

- A Piagetian constructivist perspective
- Vygotsky's social-interactionist view
- Vygotsky's ZPD notion (for long a paradigm more so than methodology; Kozulin, 2005)
- Scaffolding
- Feuersteinian mediated learning experience
- Self-regulation which encompasses some form of non-linear growth trajectory

Such a framework of course is characteristic of general practice from several theoretical positions but perhaps is yet to be seen in practical use as one model! Chapter 5 illustrates various models' use of the above-mentioned assumptions as theoretical underpinnings.

Dynamic assessment straddles curriculum-based assessment along with general adaptability within life making it expressly useful over a larger domain; i.e. low achieving individuals may well score higher on intelligence estimates (Elliott, 2003). Cognitive training and dynamic assessment have been equated as methods of inducing change thus further elaborating the methodological spectrum of possible alternatives for learning potential assessment (Scharnhorst & Bűchel, 1995; Schneider & Ganschow, 2000). It places the individual, usually but not exclusively young children (Kahn, 2000; Klein, 1992a; Lidz, 2000b; Mearig, 1987; Samuels, Lamb & Oberholtzer, 1992; Tzuriel, 2000c, 2000d; Tzuriel & Haywood, 1992), at the centre of the assessment process and regards change within the child as criterion (Burns, Delclos, Vye & Sloan, 1996). Although dynamic assessment is also amenable to group assessment (Luther & Wyatt, 1996; Rand & Kaniel, 1987; Tzuriel & Feuerstein, 1992; Ukrainetz, Harpell, Walsh & Coyle, 2000) practical problems inhibit its wider scale usage especially in South Africa (Miller & Bradbury, 1999). The individual becomes a reciprocal respondent responsible for the self-monitoring of strategies whilst the assessor engages the situation as facilitator (Schneider & Ganschow, 2000). The notion of a critical age for development of certain skills akin to Piaget's stage-like model of human development informs the more clinical approach towards dynamic assessment as younger children are perceived to be more malleable to interventions of various sorts. Moreover, children under the age of five evidence inconsistent results on traditional measures of learning ability (Vye, Burns, Delclos & Bransford, 1987) due largely to the fact that evidence attests to many critical periods of development where neuronal overproduction is followed by selective tailoring and so on through progressive development (Dehaene-Lambertz & Dehaene, 1997).[80] Depending on the literature, Piaget's notion of cognitive structures being independent of environmental influences at this early age is either refuted or upheld (Campbell & Ramey, 1990). Socio-ecological variables within the child's environment during critical stages of intellectual development impinge on development trajectories (neurobiological as well as social) and results in rapid development of these intellectual skills (or not, depending on the context) (Blair, 2006; Haywood & Switzky, 1992). Piaget acknowledged the role of parents in providing opportunities for children to develop but Feuerstein and others have placed even greater emphasis on the roles of parents as active and influential modifiers of children's development (Tzuriel, 2000b). Recall that broad-based Piagetian theories are just that; broad and based on average developmental paths where individual development trajectories vary among children (Fischer, 1993). By assessing the individual and individual differences within structural models and doing so within context, dynamic assessment is able to escape averages, generalities and monolithic developmental ladders (Lautrey, 1993). However, a recurring theme in this thesis is the concern over statistical and clinical decision-making and how this influences individual lives for better or worse. External influences are more influential than

[80] Yet another reason why biological/neuronal studies need to be factored into cognitive/psychological studies especially in the terrain of intelligence assessment and learning potential change-based assessment (Estes & Bartsch, 1997; Feldman, 1997; Haith, 1997) .

previously thought by Piaget and development occurs within domain specific tasks as well as context-specific areas and is not bound by general development across domains (Case, Okamoto, Henderson & McKeough, 1993).

The mechanisms in place during the learning process co-occur in a contextualised situation where development is directed by both the individual (the brain constructs experience as well as regulates behaviour by the manipulation of symbols) as well as social forces such as peers, teachers and parents (who render the symbols meaningful to the child or peer via culturally evolved cognitive tools and do so in a co-constructed process) (Arievitch & Stetsenko, 2000; Jensen, 1992; Portes & Vadeboncoeur, 2003; Schwebel, 1992). This makes the entire programme one of socially embedded learning as opposed to mainstream isolated learning (Brown, Campione, Webber & McGilly, 1993). Collaborative mediation may result in emergent functions which have yet to express themselves internally; i.e. external manifestations of cognitive functions may over time become internalised but only after active collaboration (Kozulin & Garb, 2002)[81] as well as the internalisation of activity via language and thought (Das & Conway, 1992). There is a particularly strong blend of constructivism inherent in understanding the developing child as well as teacher-student interaction (where learning theory and teaching practice needs to be bridged) (Meyer, Cliff & Dunne, 1994; Schur, Skuy, Zietsman & Fridjhon, 2002), which if taken in tow with the author's affiliation for reductionist and scientific manners of explication of development can be said to be at odds. This is deemed not to be the case. Here, this intuitive appeal of dynamic assessment's fundamental aims and allure is readily apparent and forms part of current test models (Guthke & Beckmann, 2000a; Jensen, 2000). Construction of experience is both an individual and environmental phenomenon that can be studied scientifically and is consistent with the views expressed by Vygotsky and Piaget in which the progression towards higher cognitive functioning is set about via mechanisms of construction of information and not merely progressive transferral (Lloyd, 1995; Mynhardt, 1995). This is of course the hypothetical best case scenario which we know is often not the case in reality[82] especially, it has been argued, in school settings, where collaboration between teachers and students is anything but mediatory and any such efforts purported to manifest such mediatory characteristics are disguised (Beveridge, 2000).

The niche for dynamically assessed computer mediated approaches is manifest in situations where human contact with each individual is not feasible (Gerber, 2000) and offers mediated experiences which do not necessarily detract from the philosophy behind Vygotskian and Feuersteinian mediation techniques. The discipline of psychology has focused more on the individual within society than on society within the individual and as such the influence of the " social" is often vague in its meanings (intrapersonal, interpersonal and intergroup) (Finn, 2000). In fact, depending on one's philosophical affiliation or at the very least, the emphasis placed on various aspects within the broader contextualised approaches of understanding development such as mediated learning experience, socio-cultural approaches and/or skill transfer, these approaches can rest comfortably within a larger nested approach known as cultural theory, of which there are numerous models with varying degrees of emphasis on different aspects (Mastergeorge, 2001). As with many concepts within dynamic assessment, mediated learning experience (the pivotal aspect within Feuersteinian theory) as a definition is often conceptually blurred (Miller & Yager, 2001). Mediation is thus a fluid concept with changing emphases regarding its meaning and utilisation within differing contexts (Miller, 2003a). Mediation within the Feuersteinian model depicts the notion of cultural transmission of knowledge and the development of individual cognition within the broader culture (Deutsch, 2003), going beyond Piaget's decontextualised[83] theory of growth and development by placing the developing individual within a context. Vygotskian mediation follows the ideal of making available requisite tools (language and thought via signs and symbols) in assisting the developing child with progress into a zone of near development, without which this zone may not be crossed. The emphasis within this type of mediation is placed on the development of higher mental processes firstly via the aid of an adult (or peer) and thereafter the mediation of this effort via the child him or herself. Once the transfer from adult guidance to child-initiated guidance has occurred one can state that mediation has been successfully implemented (Karpov, 2003). The Feuersteinian notion of transcendence (transfer of mediated skill) and the transfer of mediation from adult or child within the Vygotskian system is evident. Feuersteinian mediation emphasises cognition-in-culture and Vygotskian mediation emphasises tools-towards-higher mental processes but both take cognisance of the fact that development does not and cannot take place within a decontextualised environment and both account for the

[81] Recall (if readers can think this far back!) to the days in school where your more able peer beside you (unless you happened to be the lucky able peer) was able to explain something to you in a briefer and far more understandable format than the teacher. It is precisely because the information was channelled from an age related peer in the context of school friend that made the transfer of information easier (Mynhardt, 1995). One was also less scared to ask your peer than the teacher.

[82] In academic treatises such as this, the hypothetical situation is often described, and so, statements of this sort are a frequent occurrence. The reality, however, is often severely different. Theory needs to anchor itself at some point in some manner and so sentiments often take the form of formulaic statements. There is nothing wrong with this and is necessary, but to stylise the prose by moving away from the reality will only confound theory at a later stage.

[83] Very much the main criticism levelled at psychometric and laboratory-based approaches towards the study of intelligence as tasks are assessed without due concern for context and content. Content and context invariably influence cognition (Wellman & Gelman, 1992). This is quite obviously true but perhaps one can argue that to study the degree to which a synapse carries current is rather contextless but that the overall effect of growth and development is very much context-bound. Here one can quite vividly view the disparate research agendas for both static and dynamic assessment (Gardner, Kornhaber & Wake, 1996).

internalisation of information as originally taught or copied from another. The bioecological[84] model of development and its close ties with epigenetic models of growth allow for a link to be made between dynamic assessment and intelligence, the latter emphasising innate structures more or less in keeping with Piagetian development within an abstract system where the individual's development is almost played out by the unravelling of its pre-determined code (Karpov, 2003). The adult mediator in this instance is not given as much regard for their role in aiding developing to newer levels (Haywood, 2003). Neo-Piagetian considerations of mediation re-look the role of external mediators as "tools" from which the developing child needs to remove themselves in order to progress to new levels of growth, in other words, revisiting self-mediation (which is similar to the sentiments echoed by Vygotskian notions of the mediatory cycle) (Haywood, 2003). Conceptual, procedural and metacognitive knowledge is mediated within the neo-Piagetian set-up via a process of questions and not via a process of hinting as is done in other set-ups favouring other dynamic assessment origins (Haywood, 2003). Children discover the rules for themselves and provide their rendition of a rule as opposed to applying a rule that is taught to them (Haywood, 2003) which brings one to the question of how rule identification is understood during both types of processes, for there is both an opportunity and a necessity for providing a rule to be applied and allowing for a rule to be discovered. Either way, a more experienced person is placed within the assessment situation; a commonality running throughout the broader working of dynamic assessment.

Dynamic assessment's definition is one built from a myriad of other definitions and as is the case with a definition for intelligence, a definition for learning potential or dynamic assessment is similarly vague and diverse or loosely structured (Ghesquière, 2002; Hamers, Hessels & Pennings, 1996; Lidz, 2001; Reschly, 1997). It often refers to a host of approaches (Feuerstein, Rand, Jensen, Kaniel & Tzuriel, 1987) evidencing a healthy diversity of approaches[85] (Bransford, Delclos, Vye, Burns & Hasselbring, 1987) but it does emphasise trainability of thinking[86] and reasoning abilities which mainstream assessment does not in general do (Resing & Roth-Van der Werf, 2002). Dynamic assessment, like its intelligence counterpart also lacks a unified theoretical framework (Campbell & Carlson, 1995). Linking diagnoses with treatment is the essence of this approach towards assessment which seeks to modify through active intervention and remediation (Campione & Brown, 1987; Lidz, 1987a). Modifying the content as well as the structure of thinking, dynamic assessment aims to bridge gaps in cognitive skills and seeks to manoeuvre away from placement of individuals in categories towards inclusive understanding of malleable change where "true ability" as a concept is meaningless (Gamlin, 1996). Moving away from product-based approaches towards the assessment of individuals which in the past has been dealt with by simply ignoring the responsiveness of the testee to the test situation as well as ignoring strategies for interventions, dynamic assessment aligns itself to an attitude of holism (Bransford et al., 1987). It has much to offer the field of intellectual assessment due to its unique stance on measurement and modification of skills within a remediatory framework (Budoff, 1987b; Das & Conway, 1992; Feuerstein, Rand, Jensen, Kaniel & Tzuriel, 1987). It seeks to mediate and remediate errors in thinking as opposed to simply ignoring them, as is usually the case (Laughon, 1990; Luther, Wylie & Rosenthal, 1996; Van der Aalsvoort, Resing & Ruijssenaars, 2002). Transfer of task related information is the goal of remediation but the difference between transfer and actual learning is often blurred and indistinct (Butterfield, Slocum & Nelson, 1992) with transfer estimates being notoriously difficult to achieve (Campione, 1989; Crawford & Das, 1992). Indeed, lack of transfer was the major reason why early intelligence research into the relation between IQ and learning proficiency was not supported and eventually abandoned (Brown, Campione, Webber & McGilly, 1993). Transfer, maintenance[87] or even adaptability (for that is in effect what is being concluded and what Vygotsky envisaged within his ZPD; the eliciting of change through tasks that "provoke cognitive adaptation"; Craig, 2000, p.7) has been linked to intelligence measures evidencing higher intelligence levels concomitantly with greater ease of transferral (Brown & French, 1979; Day, Engelhardt, Maxwell & Bolig; 1997; Ferrara, Brown & Campione, 1986). Better use of metacognitive functioning eases transfer of cognitive skill and increases the duration of transfer (Hamers, Hessels & Pennings, 1996) between domains which is why metacognition is emphasised later on under the section discussing intelligence. This is one of the many examples or instances where the interchangeable nature of both static and dynamic constructs come to the fore. The notions of each are difficult to define, and the situation is compounded by continuous tautologous referral to definitions within and between the approaches. Hence, dynamic assessment's entanglement. It is wedged in a gulf seemingly unbridgeable (see figure 5 below) as intelligence and learning are related yet manifest as separate constructs (Kanevsky & Geake, 2004). A possible retort to the argument encapsulated in the figure may be that learning potential and IQ are not problematic for some studies.

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[84] One should not confuse the ecological criticism against constructivism which states that what is perceived in the environment is not changed in any way by cognitive factors (constructivist) in perception with the contextually-based understanding underpinning the bioecological approach to human behavior (Grieve & Van Staden, 1988).

[85] Which is precisely where the problem for some researchers lies - the field's lack of coherent definition.

[86] And in some instances, trainability in skills and crafts, which are areas of motor ability (Ackerman, 1988). Robertson and Mindel's (1980) study is a refreshing look at the utilisation of trainability within more technical and physical set-ups. The author may well look into this at a later stage as South African is currently (2006) experiencing a shortage of skilled technicians in a number of areas such as plumbing, welding and the like. One could perhaps identify trainability of skill dynamically and here one would most assuredly not be using or testing for "static" intelligence constructs as commonly understood.

[87] Transfer and maintenance cannot be equated as conceptual constructs as it has been shown that dynamic assessment has predicted transfer but not maintenance within certain tasks, highlighting once again, the tentative nature of our semantics within this and the intelligence domain (Day & Cordón, 1993).

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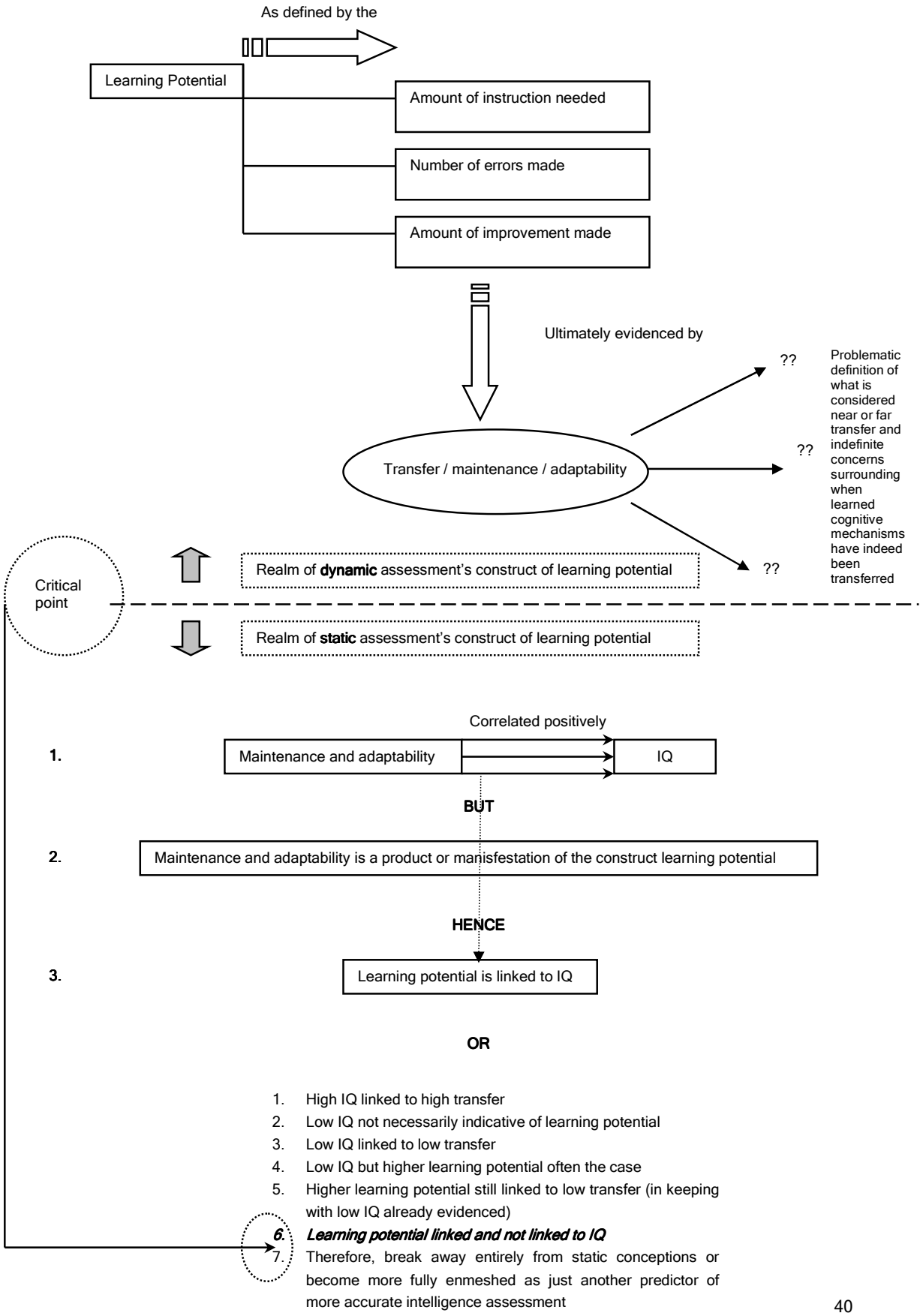
Just such a scenario as provided below may be of no consequence in any event as most studies assessing for learning potential validation are focused on below average performers where learning potential is a better indicator of future success as opposed to IQ or school marks (Miller, 1998) (not to mention the added group of low learning potential scorers for whom nothing is usually recommended).[88] But of course dynamic assessment is not only utilised within these populations which is why one is saddled with the issue. The literature is replete with efforts to link learning potential to intelligence whether manifestly or in a veiled fashion. Nevertheless, ultimately, the goal of any intervention is to have as a result the far reaching transfer of skills that can be utilised in disparate contexts with similar underlying principles.

[88] Perhaps this is unfair to highlight and use in this argument. Low IQ performers with paralleled high LP (learning potential) measures are the ideal group with which to work and advocate the necessary in terms of promoting dynamic assessment. However low IQ and also low LP individuals are considered out of the range of even dynamic assessment's grasp (the author is also not referring to mentally retarded individuals for whom early dynamic assessment initiatives allow them access out of predefined and discriminatory categories). Dynamic assessment could, then, be said to treat borderline cases more effectively than either of the extremes. Initial high-level performers can be disadvantaged by dynamic assessment interventions for whom working strategies are already functioning optimally and should thus be left to attend to their own cognitive devices (Snow & Lohman, 1984).

Figure 5 The inseparability of IQ and learning potential and the iron-clad grip of IQ upon dynamic constructs



Dynamic assessment assumes constant change throughout life and this is reflected in similar assumptions concerning changes within the assessment process (Sternberg & Grigorenko, 2002). Contextual as well as inherent characteristics are deemed equally important allowing for this method of assessment to be utilised in various cultural contexts (Cole, 1996a; Das, 1987; Guthke, 1993a; Haywood, Tzuriel & Vaught, 1992; Hessels & Hamers, 1993; Jensen, 1992; Schardt, Whitten & Gamlin, 1996; Van de Vijver, 1993). Other contexts include the learning disabled, mentally handicapped, socially and economically disadvantaged contexts (Khani & Gamlin, 1996), which is usually related to children (Missiuna, 1996; Tzuriel, 1996). Incidentally, through the intervention strategies of dynamic assessment, misdiagnosed individuals can at times be more correctly diagnosed (or at least diagnosed more accurately) (Popoff-Walker, 1982) which parallels the phenomenon of decreased diagnoses in the number of mentally retarded individuals with a concomitant increase in the number of learning disabled individuals seen in the United States for instance (Budoff & Friedman, 1964; Folman & Budoff, 1971; Shepherd, 2001).[89] It must be noted that such labels can themselves be considered as socially constructed conveniences for those doing the labeling and this in turn helps to perpetuate a situation already suffused with contradiction and myth (Valencia & Suzuki, 2001).

Mediation is consciously directed at children with the aim of assisting them in making sense of their environments which if not provided can lead to severe backlogs in emotional as well as intellectual development (Klein, 1992b). Here it is immediately apparent that the "social" plays a very important part in dynamic assessment ranging from clinical interventions to the more standardized approaches.[90] Mediation need not only be social but can also take the form of symbolic agent which according to Vygotskian thinking is revealed to the child through symbols proceeding from cultural transmission (easier to learn) to higher cognitive functioning symbols (more abstract) (Kozulin, 2002b). Clinical mediation (versus the more standardized approaches) is particularly pertinent in societies where disadvantages in education, lack of educational services and parental mediation are rife such as in South Africa (Bedell, Van Eeden & Van Staden, 1999; Engelbrecht, 1996; Shochet, 1992; Skuy & Mentis, 1992) which in the past approached poor performance from a child-deficit point of view largely inspired from the medical diagnostic model based on identifying weaknesses (Archer & Green, 1996; Bejar, 1984; Kriegler & Skuy, 1996; Robinson-Zanartu & Aganza, 2000) ("deficit" in mainstream assessment vs "potential" in dynamic assessment). It has been stated that the disreputable notion of deficit model thinking or genetic pathology model has resurged in the recent past with texts reminiscent of eugenicist thoughts (Valencia, 1997a; Foley, 1997) although one has to be exceedingly careful with statements "for" or "against" these types of texts. Not all statistical delineations of various intelligence assessment results are necessarily tinged with biased arguments. Nevertheless, there is a progressive trend towards the understanding of the processes involved in developmental assessment which vie for the attention of the intelligence researcher which emphasizes the reversal of the effects of sub-standard environmental influences as opposed to unthinking acceptance of irreparable "damage" (Pearl, 1997). There has in the past appeared a trend in which prescriptions for deficit model thinking could be said to have been applied (Valencia, 1997b). During various times, a counter-resurgence of alternative assessments operating in stark contradiction to these trends surfaced, among the most visible being dynamic assessment. Feuerstein's mediated learning has proven exceptionally applicable in cross-cultural societies, the very population for whom it was intended. It has thus evidenced success within South Africa where mediated learning concepts are directly translatable into cognitive, emotional and cross-cultural dimensions (Skuy, 1996) notwithstanding its obvious time and cost related disadvantages (Skuy & Mentis, 1990). Familiarisation with test content has been a known factor in cross-cultural psychological testing for many years indicating its fruitful area of implementation quite early on (Biesheuvel, 1972; Ortar, 1972) although test familiarity as instituted within a practice session does not constitute a dynamic intervention (Lidz, 1992b). Interestingly, Tzuriel (2001) cites the work of South African researcher Shochet (1992) who looked at dynamic assessment's applicability in tertiary education in South Africa but is cited as the only exponent of dynamic assessment within this context. Despite dynamic assessment's applicability across a broad arena of implementation, it has found a particularly rich niche in South African tertiary education, a trend, it seems, which is relatively unique to this country.

The typical mode of a dynamic assessment intervention closely follows a test-retest design which is punctuated by varying levels of mediation (Budoff, 1987a; Campione, 1996; Elkonin, Foxcroft, Roodt & Astbury, 2001; Hamers & Resing, 1993; Klein, 1992a; Lidz, 1987a; Lidz & Pena, 1996; Taylor, 1987; Tissink, Hamers & Van Luit, 1993). Mediation via a process of observation as well as participation results in lower common variance accounted for as opposed to the utilisation of two tests for instance (Haywood & Tzuriel, 2002). Along with decreased explainable variance newer change-based IRT can more successfully accommodate

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[89] What was considered a "moron" by Goddard is no longer considered as such (1912) nor is a "backward" child backward (Burt, 1937; Fletcher, 1991). Is it possible that this type of labeling is still prevalent? Another niche which dynamic assessment can quite readily fill is the re-evaluation of cognitive functioning and the resultant move away from the medical model of categorization although as it is currently understood, learning disabilities are in fact due to "basic disorders in specific psychological processes that are a reflection of neurological, constitutional, and/or biological factors" and not due to emotional or physical disorders nor are they related to general intelligence (Swanson, 2005, p.409). This is particularly pertinent here as learning disability research has often evidenced deficits in working memory, which as a construct is often related directly to intelligence.

[90] At times the vague definitions of what in fact dynamic assessment is can be seen in encompassing measures of potential where by merely readjusting statistical givens on a traditional IQ test (Taylor & Richards, 1990) sufficient change has said to have been made. That this would suffice as "dynamic" is questionable.

change as a construct (see chapter 4 for more on this). Depending on the nature and underlying philosophy[91] of measurement, the intervention can take place via clinical and intensive mediation through to a structured progressive hinting and somewhat more standardised approach (Burns, Delclos, Vye & Sloan, 1996). This format of assessment allows for better prediction of school results, yields more information than mainstream testing on both the strong and weak cognitive points during performance and the information gathered is relevant to the instruction being given (Meijer, Oostdam & Van der Sluis, 2002; Tissink, Hamers & Van Luit, 1993). Depending on the amount of control exercised within this structure, it can be loosely classified as a classical quasi-experimental design (Klauer, 1993). It is, however, considered as undesirable within standardised assessment (Klauer, 2002) but this is counter-intuitive for at least one reason: that of construct validity (Hamers & Sijtsma, 1995; Lidz, 2003) for how much closer can one come to assessing learning than in the actual process of learning (Lidz & Gindis, 2003)? It is envisaged that the future of intelligence assessment will focus on issues of content and construct validity thus enabling better extrapolations of test results to other aspects of learning and intelligence (Kamphaus, Petoskey & Morgan, 1997). Feuerstein's Learning Propensity Assessment Device (LPAD) is in fact both a product and informer of the theory that underlies it, namely, structural cognitive modifiability (SCM) (Feuerstein, Feuerstein & Gross, 1997) and has been in use since the 1950's (R.S. Feuerstein, 2000). This process manner of considering human functioning within the broader environment is reminiscent of the thinking of Piaget and Vygotsky, although the latter two do not cohere entirely on various points of view within educational theory (DeVries, 2000). In this manner, substantive theory is upheld in opposition to the more traditional hypothetical theory (more on this in chapters 3 and 4).

Aspects considered as error within static assessment such as fatigue, stress and lack of attention for instance are what make for diagnostic decision-making within dynamic assessment (Lidz, 1997). The rationale underlying static and dynamic types of assessment are radically different, philosophically and fundamentally but as Guthke and Beckmann (2000a) so aptly point out, static components are included within dynamic assessments but not the other way round thus giving dynamic assessment more of an edge so to speak. Moreover, most individuals do not utilise all their resident potential and this will inherently not be picked up within static assessment in any event (Resing, 2000). Due to the unique nature of the interaction (Missiuna, 1996) between the testee and the tester in dynamic assessment however, validating variable constructs can become problematic especially when the interaction between the testee and assessor also varies between test situations (Burns, 1996) where specific target group interventions are necessitated and thus change from one context to the next (Guthke, Beckmann & Dobat, 1997). Reliability and validity issues from psychometric theory start asserting their presence in this regard. Over and above the preoccupation with prediction, dynamic assessment aims to explain in addition to predicting scores in school tests thus making it a more instruction-based approach (Ruijssenaars, Castelijns & Hamers, 1993). It creates a profile of the learner's behaviour by adapting and attenuating intervention programmes to more readily suit the individual and in this way compiles an individualistic account of the person within the assessment situation (Greenberg & Williams, 2002). The process-based approach allows for explanation of cognitive deficits usually far in excess of anything offered by most mainstream assessments. Three main attempts at modifying traditional psychometrics include a re-interpretation of test score results to reflect a more culturally attuned approach; the modification of test items which evidence contextualised individual functioning (cultural and developmental) and lastly an attempt to modify functioning beyond that which is recognizable as manifest (Feuerstein, Rand, Jensen, Kaniel & Tzuriel, 1987).

Mediation effectively spans purely qualitative interventions in which intensity and duration (minutes to years) is emphasised in a clinical set-up such as offered by Feuerstein and Jensen for instance (Elliott, 2003) where domain-specific tasks are avoided due to their similarity with school related tasks (Greenberg, 2000; Lidz, 1997). It also spans standardised quantitative testing within a decidedly more psychometric approach, as offered by Budoff, Campione and Brown with the adaptation of certain psychometric tests to reflect a more dynamic approach such as Swanson's cognitive processing test which is based on information processing theory (Budoff, 1987a; Campione & Brown, 1987; Feuerstein, Feuerstein, Falik & Rand, 2002; Jensen, 2000; Lauchlan & Elliott, 2001; Minick, 1987; Sternberg, 2000a; Swanson, 2000; Wiedl, 2002; Wiedl, Guthke & Wingenfeld, 1995). The emphasis in dynamic assessment education and clinical set-ups is on people as opposed to scores (Wiedl, 2002) and normative functioning (Das & Naglieri, 1992) which is divergent from the emphasis placed in mainstream preoccupation with only scores in a number conscious society (Tzuriel & Haywood, 1992) (although there is increasing awareness and acceptance of developmentally and criterion or curriculum referenced tests which facilitate further the integration of instruction and assessment; Kahn, 2000; Lidz, 2000b). Dynamic assessments are concerned with understanding and aiding individuals in their development and many models do not emphasise normative profiling or classification to categories of achievement (Jensen, 2000), but such stratified norming does indicate the degree of loss of performance in certain cognitive areas which will then need to be dealt with in terms of understanding why performance is so low (Jepsen, 2000). Assessing for higher education potential is a particularly thorny issue, especially in South Africa where assessment of general thinking skills may allow for greater numbers to access higher education, but without the requisite domain-specific skills many may well struggle to cope with the system.

[91] Recall that once a method or measure or statistical technique is employed to discover data or knowledge, consciously or unconsciously a decision has been made regarding the underlying assumptions of what it is one is studying (Ridgway, 2000). Many may simply be unaware of this.

Moreover, it is well evidenced in the literature that domain general dynamic assessment interventions do not transfer well to other domains, hence the need to dynamically assess domain-specific skills (Samuels, Killip, MacKenzie & Fagan, 1992) which was attempted as early as 1987 in South Africa utilizing Feuerstein's LPAD (Skuy, Archer & Roth, 1987). There is a need for both types depending on the circumstances. A balance between general thinking and domain specificity is needed. It is well known that knowledge structures already in place aid in the generation and accumulation of yet more knowledge in a snow-ball type effect (Minnaert & Janssen, 1996).

Static measures can be utilized and extended dynamically (Lidz & Thomas, 1987) and is a process often turned to in South African research (Murphy, 2002, Murphy & Maree, 2006). The role of assessors is an emphasised concern within dynamic assessment as they do not play a passive role but rather seek to engage the individual in such a way as to encourage development and change within the transactional process (Ghesquière, 2002; Grigorenko & Sternberg, 1998; Lidz, 1997; Minick, 1987). They can be considered as filters for children aiding in the expansion of their cognitive repertoire as well as guiding them in their cognitive choice of strategies (Jensen & Feuerstein, 1987). The assessment procedure can quite rightly be referred to as a consultation (Lidz, 1981). Cultural minorities often experience language difficulties and this is typically the situation in the West where there is limited English language proficiency in some instances;[92] but this is not necessarily indicative of language deficiency (Lidz, 1997; Losardo & Notari-Syverson, 2001). There is a monumental difference between the two and this difference is often ignored. Hence dynamic assessment interventions and alternative assessments are more often than not non-verbal in mode (Lidz, 2001; McCallum & Bracken, 1997) and rely heavily on pictorial test matter (Schur, Skuy, Zietsman & Fridjhon, 2002) very similar to cross-cultural modes of assessment (Cortada De Kohan, 1972). The main goals of dynamic assessment within a clinical set-up are characterised by concern with the:

- initial level of performance, used within conventional testing but here it informs the mediator as how best to handle the particular individual
- nature and amount of mediation
- nature of the deficient cognitive functions
- non-intellective factors, currently perhaps the most under emphasised aspect within assessment in general
- maintenance and transfer of learning
- type of modality used to channel the test and the
- effects of various mediatory strategies

(Tzuriel, 2001, pp.47-48)

At this juncture in the discussion on dynamic assessment fundamentals it has become evident that the approach is one of assessment intermingled with teaching most often within the framework of Vygotsky's ZPD or some such similar model (Snow, 1990). Table 1 bears testimony to this notion and illustrates the commonalities and differences between assessment and teaching within dynamic assessment focusing specifically on two particular research efforts. Table 2 illustrates the main differences between dynamic and static assessment. Table 3 presents a comparison between the two approaches but from an alternative view point depicting the reality of the situation regarding the utility of both methods of assessment. This thesis, although fundamentally in support of dynamic assessment cannot ignore or put aside the very many positive aspects encountered within traditional forms of intelligence assessment and in so doing the author seeks to objectify arguments within the discipline of psychology which prides itself on its scientific status after all. Figure 6 illustrates the author's understanding of dynamic assessment's take on development as emanating from specific research agendas.

[92] This is another major point of contention within South African universities at the moment. Determining language proficiency and general aptitude for academic achievement are two completely separate issues in terms of inherent intelligence. Failure to progress due to language problems and failure to progress due to lack of sound schooling or a lower level of intellectual performance are three areas which are often difficult to tell apart. But these aspects will need to be pried apart if one is to successfully choose from a population those who will likely succeed even though language is a barrier as well as prior low quality education as determinant. It is the contention of this thesis that dynamic assessment indeed has a large role to play (even within tertiary education as dynamic assessment is not only applicable to individuals of a certain age; De Beer, 1991) but if it is to do so in any measurable way, it will need to re-look its stance and placement within the larger intelligence assessment field.

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Table 1 Assessment and teaching within dynamic assessment: commonalities and differences (Brown, Campione, Webber & McGilly, 1993, p.175)

Assessment and instruction compared	
Zone of proximal development	
Collaborative assessment environments (the work of Campione and colleagues)	Collaborative (reciprocal) teaching environments (the work of Brown and Palinscar and colleagues)
Main similarities	
Based (loosely) on Vygotsky's learning theory	
Involves guided cooperative learning with expert feedback	
Strategy modelling by experts (apprenticeship model)	
Externalizing mental events via discussion formats	
On-line assessment of novice status	
Help given, responsive to student needs	
Aimed at problem solving at the level of control structure (metacognition, intentional learning, learning to learn)	
Understanding measured by transfer, flexible use of knowledge	
Main differences	
Goal - individual assessment	Goal - cooperative learning
Test - knowledge and strategies	Teach - knowledge and strategies
Aid - standardized hints	Aid - opportunistic
Hints - hard to easy to measure student needs	Hints - easy to hard to scaffold student progress

Table 2 Main features differentiating dynamic assessment from static assessment (Morrison, 2001 p.308; Tzuriel, 2001, p.7)

Dimensions of comparison	*Dynamic assessment*	*Standardised testing*
Goals of testing	• Assessment of change • Assessment of mediation • Assessment of deficient cognitive functions • Assessment of nonintellective factors	• Evaluation of static performance • Comparison with peers • Prediction of future success
View of the learning process	• Dynamic, unpredictable	• Predetermined and linear
Orientation	• Processes of learning • Metacognitive processes • Understanding of mistakes	• End products (static) • Objective scores • Profile of scores
Assumptions about the learner	• Active - invents new knowledge	• Passive - acquires existing knowledge
Context of testing	• Dynamic, open, interactive • Guidance, help, and feedback • Feelings of competence • Parents and teachers can observe	• Standardised • Structured • Formal • Parents and teachers are not allowed to observe
Origin of standards	• Evolves with the knowledge invented in the process	• Externally determined and applied to the learner
Role of evaluation	• Ongoing - part of the learning process itself	• End point of learning
Interpretation	• What people learn, what they say they learn and how they learn it	• What learners can produce
Purpose	• Recording, interpreting and reinterpreting process	• Measuring and judging according to existing norms
Interpretation of results	• Subjective (mainly) • Peak performance • Cognitive modifiability • Deficient cognitive functions • Response to mediation	• Objective (mainly) • Average performance
Assumption about the evaluator	• Partial and limited - needs learner's perspective	• Neutral and objective - unchallenged authority
Nature of tasks	• Constructed for learning • Graduated for teaching • Guarantee for success	• Based on psychometric properties • Termination after failures
Focus	• Whole learner situated in a particular context	• Isolated competencies

Table 3 Playing devil's advocate: some not so sinister aspects of static assessment and some problematic issues within dynamic assessment

Problematic issues within dynamic assessment	***Positive aspects within static assessment***
• As currently practised and envisaged by older models of change assessment, the gain score issue remains problematic although recommendations as to its renewed manipulation within IRT change-based models are considered in chapter 4. • The time taken to administer clinical versions of dynamic assessment interventions are prohibitive within school settings as well as *en masse* testing of potential tertiary education students • The costs involved are greater due mostly to the length of time needed to administer the assessment • The need to extensively train moderators and mediators within a dynamic assessment set-up is cost and time intensive • Can at this stage only be utilised for underachieving populations which have for any number of reasons not been allowed to explore their fuller potential and has not really entered into assessment of average to above average performing students from normal backgrounds (this is a contentious statement and worthy of more debate) • Perpetuates the misguided notion that dynamic assessment is useful only for sub-performing populations and does not successfully market itself as a packaged product for an all-inclusive manner of assessment • Is not yet effectively linked with biological and neurological psychology thus falling behind in a potentially and manifestly rich area of research where funding would most likely be easier to procure • Is currently "all over the place" in terms of a methodology. Although in fairness, this can be considered a good thing • Original thoughts behind this model were usually just this: thoughts and models. The necessary theoretical backing is sometimes vague, although in some instances this is not the case and as dynamic assessment has moved into the future various models are relying more heavily on sound theory and empirical research	• Has a long history of venerable research attesting to its credibility on a number of issues • Although obviously tainted with nefarious motives throughout its historical development, the field of intelligence was punctuated by steady maturation within modelling of its characteristic traits that cannot be swept aside • Thoughtful and humane approaches towards the assessment of masses of individuals did not always leave much room for intelligence assessment to veer off in directions warranting greater concern for the individual • Dissatisfaction with mainstream assessment has at times appeared fashionable which can be unduly harsh and simply unscientific in rhetoric • There is much to be said for the physiological basis of intelligence and decrying or dismissing reductionist approaches of biological views on intelligence is also not scientific • Contextual, bio-ecological, systemic, environmental and many such development-framed inclusive models of intelligence are intuitively appealing and most likely the more correct explanation of what and how intelligence is and functions. But such models are inherently complicated and are further complicated by the sparse methods currently available to fit them into models evidencing intelligence and potential • Nature evidences a bell curve distribution concerning a number of issues and ignoring this regarding intelligence is not only short-sighted but scientifically unfair and doing so does a disservice to the enterprise of knowledge-gathering. Life in its varied forms is often "unfair" and finding intelligence scores distributed across a spectrum is not something against which we can fight. The situation is that there is such a distribution and the best we can do is to regard each segment with dignity and fairness realising concurrently that no-one is a victim of their biography. Low functioning performers exist, have existed in the past and for the foreseeable future will exist and no amount of interventions will cause this distribution to change. Dynamic assessors must understand this well even though this type of statement is one which is very rarely encountered in dynamic assessment texts. Having said this, the support for dynamic assessment from this author is nevertheless upheld.

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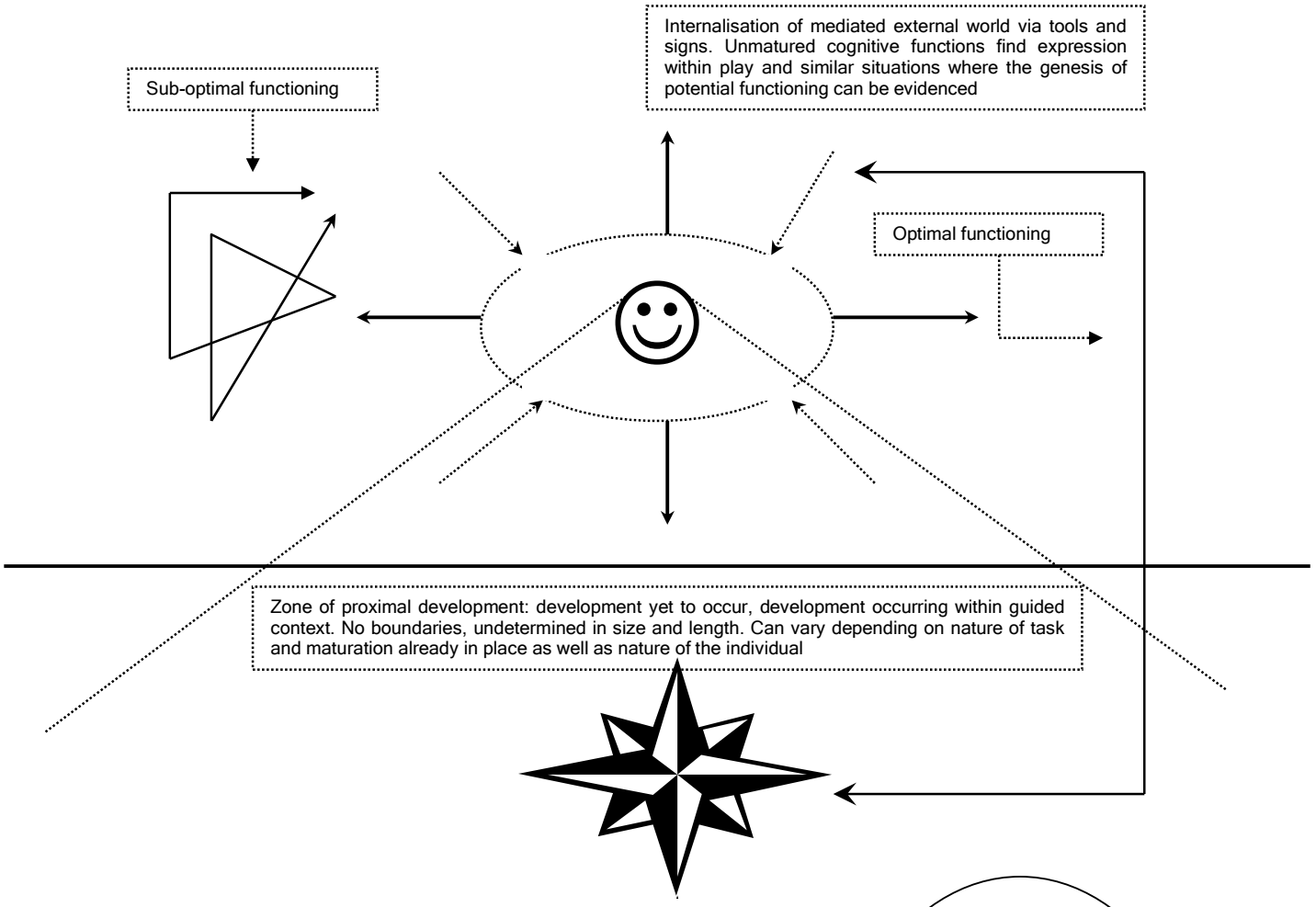
Figure 6 Dynamic assessment and the understanding of development



2.7.1 History

Dynamic assessment has a history with disparate origins depending on the manner in which you choose to view it but can be said to have a long past but short history (Haywood & Tzuriel, 2002; Lidz & Elliott, 2000b; Wiedl, 2002). Some may laud Lev Vygotsky as the founding father due to his unique concept of the zone of proximal development within a socio-cultural theory (Elliott, 2003; Hamers, Hessels & Pennings, 1996; Hegarty, 1988), which states that cognitive performance, when aid is provided, will result in the best measure of ability (Hamers & Sijtsma, 1993; Meijer, 1993; Shamir & Tzuriel, 2002) thus birthing the learning test (Guthke, 1982). Reality as such is never met with face-to-face but engaged with via tools of mediation (Netchine-Grynberg, 1995). Depending on the level of support received by a child on a task, varying outcomes can be expected; performance at the functional level is expected with minimal or no support as opposed to optimal performance when supported in a task (Suizzo, 2000) and clearly distinguishes between "performance" and "competence" (Gelman, 2000).[93] His approach was later built upon by other Soviet educationalists and formulated more extensively regarding its educational implications (Haenen, 2000). Others prefer to view Alfred Binet as the progenitor due to his notion of investigating ability during the process of a test and his idea of a continuously developing latent trait. Binet looked at correct responses as indicative of ability whereas Piaget preferred to look at errors; a novel notion at the time but routinely accepted within current dynamic assessment today (Anastasi, 1998; Chalmers & McGonigle, 2000; Lidz & Thomas, 1987; Sternberg, 1997a; Styles, 1999; Ukrainetz, Harpell, Walsh & Coyle, 2000) although he was not really concerned with remediation (Carlson, 2002).[94] He also offered interesting ideas on remediation but due to its generality the idea receded into the background (Brown, Campione, Webber & McGilly, 1993).

A brief interruption …

Galton and Binet are often discussed within the intelligence literature in a dichotomised fashion, the somewhat usual mode or tendency when contrasts wish to be drawn and summated. There is surely usually more to this type of exercise than polarising views, nevertheless, Eysenck (1986) characterises the Galton-Binet differences towards intelligence as follows:

- Cognitive ability and its study was a science to Galton as has already been noted above but to Binet intelligence was a statistical artefact (here it is apparent that substantive construct and abstract construct are already evident – a theme of incongruence that was to play out till the late twentieth century)
- Genetic heritage was a predominant determinant of intelligence within Galtonian intelligence research whilst Binet was concerned with the educational environs (one has to recall that both men were working within two different contexts; the former a scientist and the latter a psychologist interested in education but most academic psychologists in the early twentieth century were more concerned with theoretical issues as opposed to practical ones; Reese, 1993)
- Galtonian measurement was predicated upon physiological bases and Binet's predicates lay within more naturalistic settings
- At times, one feels that some of our forbears have been unkindly treated by history and their reputations besmirched by incidental information vastly disproportional to much exceedingly eminent work contributed to the field of science by these scholars. Subsequently, and in keeping with the human tendency to label and categorise, some scholars become boxed in an ethereal realm from which they have no escape. Galton's work was prodigious by any standard and incredibly wide ranging in thought and scope. Binet was not immune to the tried and tested methods of his time although he did much for the future course of events within intelligence assessment by side-stepping conventionalities. Vygotsky himself did not entirely eschew the intelligence test either. Modern-day researchers should revel in the leaps made by such individuals but be likewise weary of inflating or downplaying various issues which concern us today merely because it is politically correct to do so. History is not biased but our interpretations are

Others would stake a claim for the founding figure to be Reuven Feuerstein who likewise emphasised what individuals did incorrectly in the hope of coming to understand their functioning better and did so within a mediated learning experiential environment (Büchel & Scharnhorst, 1993; Shamir & Tzuriel, 2002). At times both Vygotsky and Feuerstein are credited as equal co-contributors to the field (Haywood & Tzuriel, 2002). Feuerstein may be cited as the founding figure due to the development of his test battery within this domain (Skuy, 1989) and his published and widely recognised work on the subject matter (Lidz, 1992b). It is due largely to Feuerstein and his followers that the renaissance of dynamic assessment has flourished

[93] It has been shown that students who do well in school due to their parrot fashion learning of material at times experience a decline in marks at tertiary education institutions. Here, their performance is good but competence less so. This may work the other way round for students who have not yet evidenced maturation in certain cognitive areas and hence perform poorly but may well evidence superior competence. This competence-performance distinction is central to educability and assessment of at-risk and mentally retarded individuals (Paour, 1992).
[94] Incidentally Binet had also measured skull circumferences in his day in keeping with the times, so to paint a non-biased view of this figure as progenitor of dynamic assessment one should be in possession all the facts (Feuerstein & Feuerstein, 2001; Styles, 1999).

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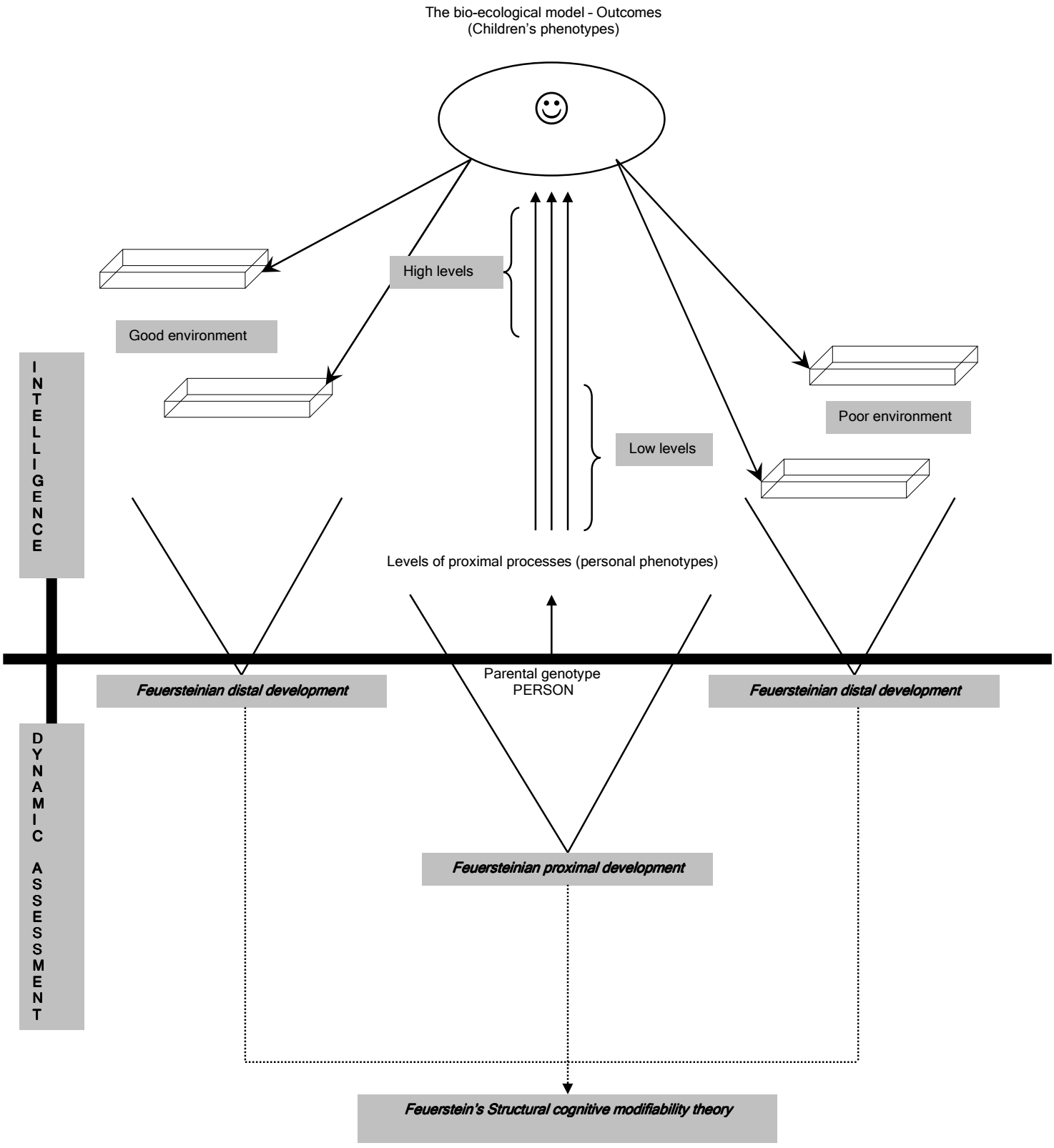
as it has especially its gradual development in the West (Sternberg & Grigorenko, 2002). His emphasis on a bio-ecological model of human functioning emphasises distal and proximal factors and thus takes cognisance of indirectly impinging variables such as genetic heritage, early childhood experiences as well as cultural and socio-economic factors playing in on the developing child. It is in keeping with developmental theories of intelligence such as evidenced by Ceci's bio-ecological theory (Ceci & Bruck, 1994; Ceci, Rosenblum, De Bruyn & Lee, 1997; Lohman, 2005; Miller, 1997). The similarity of the bio-ecological and Feuersteinian theories/models can be viewed in figure 7 below. Some of the early literature dating from the 1920's and onward regarding educability and pedagogy in general is quite prescient really in its treatment of measuring the learning process (Brown, Campione, Webber & McGilly, 1993). Although not making up the majority of the work a fair section of the material is pleasingly modern in outlook which leads one to wonder why certain ideas have indeed taken so long to gain a stronghold within mainstream pedagogy, education and assessment. De Weerdt (1927) for instance, begins her article with a statement echoing sentiments eerily similar to the ones heard today "the whole scheme of formal education is based upon the fundamental concept of *improvability*" (own emphasis) (p.547). She does go on to state that "the educator has always been interested in this *capacity* of the individual and has measured it in a more or less direct way through class achievement … we have relatively little material on the *learning* or *improvability* of children under classroom conditions" (own emphasis) (p.547). This was written seventy nine years ago.

Figure 7 Intelligence-dynamic assessment link: the bio-ecological intelligence model and the Feuersteinian dynamic assessment model (bio-ecological model from Ceci, Rosenblum, De Bruyn & Lee, 1997, p.314)



SCM (structural cognitive modifiability) assumes that modification ensues regardless of the etiology and severity of a condition as well as regardless of age. This is due to the brain's plasticity and lifelong engagement in learning (Birnbaum & Deutsch, 1996).

Socio-economic factors as well as cultural mediatory factors and their influences are felt as early as the third grade in school (Portes & Vadeboncoeur, 2003). It would make sense to intervene as soon as possible even if only from a neuronal development point of view where synapses in the frontal and occipital cortex areas for instance undergo growth until the age of twenty (if not longer) (Neville, 1994). This is in addition to the fact that remediation in general becomes successively more difficult as age increases (Humphreys, 1988) (but not necessarily impossible!). Intellective factors are only a part of the greater spectrum of aspects influencing development and mediated learning experience places cognitive, emotional and cultural dimensions on a par with intellective factors in the model (Skuy, 2002). Bio-ecological theory supports this notion as it has been shown that environmental influence has differential effectual outcomes on heritability (*h*) where *h* is a notion of populations and not individuals (Ceci & Bruck, 1994; Conway, 2005; Gordon & Lemons, 1997). It represents the degree of phenotypical (observed) differences within a population; that is results from genetic differences within the population (Grigorenko, 2004a). "Heritability is the ratio of genetic variation to total variation in an attribute *within* a population" (original emphasis) (Sternberg, Grigorenko & Kidd, 2005, p.53) and explains percentage variation accounted for, not the construct attested to. Feuerstein's emphasis on the modifiability of cognitive processes can be traced back to the time he studied under Piaget whose models of child cognition are synonymous with the developmental tradition but he later parted ways with Piaget to study under André Rey (Burgess, 2000).

Together with mediated learning experience in which the environmental challenges are filtered and attenuated for the child and which also outweigh the distal factors in the magnitude of its influence, the governing model of human development is all-encompassing and indeed very modern for the time in which it was being proffered as viable alternative to mainstream testing (Kozulin, 2002a). Vygotsky's socio-cultural approach and Feuerstein's mediated learning approach both reject the dichotomous appraisal of cognition as naturally occurring phenomenon and learning or instruction as a cultural tool. Vygotsky viewed learning, culture and development as inseparable (Mastergeorge, 2001) as any instructional interaction reflects a social interaction (Perret-Clermont & Bell, 1987). Human beings, unlike other species,[95] interact with intentional agents and engage in cultural learning from as early as nine months and acquire linguistic and other symbols necessary for communication within their cultural grouping (Tomasello, 2001). Culture and development integrate seamlessly within the learning and processing situation (Kozulin, 2002b) but Miller (1997) warns that although cultural aspects of psychometric intelligence often results in the revisiting of specific theories of intelligence, it is not always the case that the nature of intelligence itself is revisited. Cognition is framed within culture as "cultural ontogeny affects biology in a very direct way" (Feuerstein, Feuerstein, Falik & Rand, 2002, p.73), although cogent arguments are made for other sides to the debate of where and how intelligence arises. Culture, states Hunt (1997) cannot account for measurable variables and so there is no way of tracing their effects within a causal model. There are many other individual researchers as well as research groupings which can attest to having developed their own unique manner of dynamic assessment (Guthke, 1993b; Hamers & Resing, 1993; Laughton, 1990; Lidz, 1981, 2003; Resing, 1993) but most of these schools find their points of origin in one or more of those mentioned whilst some groups prefer to blend in contributions from various originators to fit their needs (Shamir & Tzuriel, 2002). The literature is often divided on the issue of the history of dynamic assessment with statements revealing that it is relatively new to statements revealing its venerable and aged heritage (Hamers, Hessels & Tissink, 1995). What is most likely being hinted at is that philosophically, the method is old and can be traced back to the early nineteenth century (despite the early Greek's writings on potential). The method is likewise young in terms of its being generally known about and widely practised or conversely not well-known even today (Freeman & Miller, 2001; Haywood & Tzuriel, 2002). Recent research evidences that dynamic assessment still has not left much of a noticeable footprint outside small societies advocating its message. One retort to this is that this is very much the story of science where numerous ideas have had to wait years, decades and in some instances centuries before the ideas latched on in the mainstream imagination. The alternative retort is that this is very much an indication of its potential demise as equally many "good" ideas in the history of science and social science have been relegated to anecdotal status. Who can tell? This is an "unknown"; the one "known" is that the idea underlying the philosophy is unflinching in its tenacity to continually surface through the ages. One must ask oneself: why? The intuitive appeal of the idea continues unabated.

Many schools of thought, have, since the days of Binet, Vygotsky and Feuerstein developed within a framework which can be considered "neo"; as in neo-Piagetian and neo-Vygotskian and so on. However, a number of isolated researchers had, in the early decades of the twentieth century, already experimented with the concept of a malleable intelligence (Lidz, 1992a) including, among others, Otto Selz (1935) (in Klauer, 2002); G.R Ortar (1959), E. Haeussermann (1958) considered the mother of dynamic assessment (Lidz & Elliott, 2000b), H. Schucman (1960) (in Lidz, 1991, 2001) with South Africa reporting the results of a dynamic-like type of assessment as early as 1961 (Lloyd & Pidgeon, 1961). A pupil of Wundt, Meumann (1922), the psychometrician Kern (1930) and DeWeerdt (1927) are other names in the early decades of the twentieth century to whom the idea of a learning test concept can be traced (Guthke, 1992; Guthke, Beckmann & Dobat, 1997). European pioneers within this tradition trace origins to the works of, among others, Quetelet (1835) the Belgian researcher (see above) and his contemporary

[95] This is contentious. There is evidence that higher primates do engage with one another as intentional agents and transmit information about symbols to each other (Rumbaugh, 2002). More research is however needed to vindicate such a claim.

Esquirol (1838), a French psychiatrist, who argued for a differentiation to be made between performance and prognoses (unfavourable conditions can lead to unfavourable outcomes[96]). Binet and Simon, (1908), Stern (1928), a German psychologist who studied the relation between environmental influences and intellectual abilities; Vygotsky (along with his students Luria and Leontiev who modified his theory of ZPD; Hamers, Hessels & Pennings, 1996), Kern (1930), who was concerned with improving intellectual performance via training and using trainability as diagnostic indicator of aptitude; Selz (1935), who concentrated on modifiability of intelligence; Piaget, Rey (Feuerstein's mentor), who researched mental plasticity; Volle (1957), who pioneered the testing-the-limits approach outside the domain of Rorschach testing where it had previously been utilised and concluded that the manner in which testing was conducted influenced the outcome, especially in low performing individuals. Boesch (1952, 1964), was influenced by Piaget and concentrated on patterns and variations of results in place of viewing only correct responses on a test. Hurtig (1962), the French psychologist who made strides in differentiating children who had suffered environmental backlogs and those who were truly retarded and Schmidt, (1969, 1971) who drew heavily on the work of Boesch and utilised his theory but further refined the testing-the-limits approach by integration of empirical and theoretical data (in Wiedl, Guthke & Wingenfeld, 1995).

European contributions towards the historical development of dynamic assessment, on the surface, does seem to have a richer history as opposed to the Western development which may partially explain why dynamic assessment has been more eagerly followed and accepted within countries outside the United States and the United Kingdom. Possibly this has resulted in more resistance to this method from mainstream assessors currently more at ease with typical intelligence tests. This conclusion is substantiated only from what has been gleaned from the literature as well as from results from studies dealing with dynamic assessment awareness surveys. Early 1920-1930's research emphasised the ability to learn as paramount and was considered, at times, more informative than the static measures hitherto used (Lidz, 1987a). It was during the 1930-1950's that the neuropsychologist Andre Rey formulated tests which were utilised later on by his student Feuerstein in the 1950's but these two decades were a period of relative quiet on the dynamic assessment front, mostly due to a variety of social, political and scientific reasons (Kozulin & Garb, 2002; Pascual-Leone, Johnson, Baskind, Dworsky & Severtson, 2000). The 1940's evidenced the insight garnered to detail the relation between intellectual achievement and intellectual potential noting the lack of covariation between the two measures (Lidz, 1987a). Practice effects had been studied in the 1920's but coaching studies came into their own in the 1950's. Original attempts at documenting the effects of coaching on performance were mainly conducted in the United Kingdom, although the emphasis was not on the improvement of capacity as such (Lidz, 1987a). Process orientated means of assessing intelligence as well as emphasis on testing the limits to which individuals could aspire were also characteristic of the 1950's and incidentally this process nature of intelligence assessment is sometimes considered quite modern in approach where there is a turn towards assessing what individuals can and cannot do within their own limits (Baltes, 1998). Sporadic attempts at assessing educability took centre stage during the 1960's and interestingly, it was A.R. Jensen who very early on stated his views concerning the biased nature of mainstream intellectual assessment batteries, deferring to more dynamic alternatives for various minority groups (Lidz, 1987a) and it should be noted that ecocultural factors also need to be factored into the readiness to limit bias even within similar cultural settings (Church & Katigbak, 1987). Learning potential measures in the United States were also becoming increasingly evident during this decade (Budoff, 1987a) due predominantly to increasing dissatisfaction with psychometric testing (Kozulin, 2005).

The 1970's witnessed an explosion of sorts in comparison to the previous decades and saw the deployment of dynamic assessment methods of mental abilities (Carlson, 1994). This decade was witness to the filtering in of cognitive science principles into the arena of intelligence; hence the hybridised field one sees today (Das, Naglieri & Kirby, 1994). During this phase, various research groups came to the fore with various points of emphases under the umbrella term "dynamic assessment" (which is partly the reason why this manner of assessment is so varied in its definitions and practical implementations). Included among others are the works of Feuerstein (who had, as mentioned, laid the ground work decades prior to this) as well as Budoff, Campione, Brown and Haywood (instrumental in bringing to the United States the work of Feuerstein) (Lidz, 1987a). Carlson and Wiedl had started their work on testing-the-limits approach in the 1970's and on into the 1980's and provided evidence for the validity of dynamic assessment as alternative approach, working specifically within the information processing paradigm (Lidz, 1987a). The 1990's and early decades of the twenty first century can be characterised by a more sedate and sceptical attitude towards this approach but ironically was simultaneously only starting to take off in South Africa (Murphy, 2002; Murphy & Maree, 2006). It was also expanding its field of research application to populations other than the traditional sphere of application, and includes among others mature students, the elderly,[97] gifted (culturally diverse and

[96] However obvious this may seem to us today in 2006, recall the period in which these esteemed researchers worked. The early 1800's was a period chiefly characterised by industrial growth, scientific development (enlightenment), the need for labour, urban migration, slow but steady creation of a rising middle class, interest in culture, greater apportionment of time to leisure activities, internecine war and an altogether renewed attempt to understand human beings and their place within the world, cosmos and universe. The founding and consolidation of new empires, countries and territories resulted in independence of many forms. It is not surprising then, that studies into mental faculties started to blossom when they did (Brinkley, 1993; Delius, Gatzemeier, Sertcan & Wűnscher, 2000; Gribbin, 2003; Roberts, 1995).

[97] Lest it be forgotten, neurons are created in the adult brain - some hope for dynamic assessment neuronal correlates approach that is advocated in this treatise (Quartz & Seknowski, 1997b).

usually undetected), at-risk foreign language learners, psychiatric, prison inmates, early brain damaged individuals, blind, deaf and speech impaired populations and is applicable to both domain general and specific contexts (language, arithmetic, writing competence, science and biology for instance) (Alfassi, 2002; Bolig & Day, 1993; Chan, Ashman & Van Kraayenoord, 2000; Glaspey & Stoel-Gammon, 2005; Guthke, 1992; Kaniel & Tzuriel, 1992; Keane, 1987; Keane, Tannenbaum & Krapf, 1992; Kester, Pena & Gillam, 2001; Kirschenbaum, 1998; Kozulin, 2000; Kozulin & Garb, 2002; Lidz, 2004; Lidz & Elliott, 2000b; Samuels, 2000; Schur, Skuy, Zietsman & Fridjhon, 2002; Silverman & Waksman, 1992; Stanley, Siegel, Cooper & Marshall, 1995; Schneider & Ganschow, 2000; Tzuriel, 2000a, 2001; Ukrainetz, Harpell, Walsh & Coyle, 2000; Wiedl, 2002; Wiedl, Guthke & Wingenfeld, 1995; Wiedl & Schöttke, 1995). These are populations which have until recently been side-lined from mainstream assessment and interventions and for whom targeted mediatory intervention programmes are deemed more suitable due their unique life contexts. Dynamic assessment is also moving into areas concerned with neurological disorders where both individual and group administration of assessment is being researched (Haywood & Miller, 2003). There is some conceptual overlap, namely, the approach towards understanding what is maximally possible after sustained injury as opposed to what is typical functioning and the effect of actual intervention within the injured patient as opposed to merely assessing it (Haywood & Miller, 2003). Perhaps the most valuable asset within the dynamic assessment arsenal kit!

Issues such as psychometric aspects, costs and time are major factors continuously lamented as constraints within this method of assessment. However, a number of prospects have since the 1990's become available in order to allow this manner of assessment a more palatable existence. New models within item response theory are currently being developed as this thesis is being written (see chapter 4 for change-based IRT models) which, simply stated, provide enhanced technology for the generation of items and assembly of tests but is as yet unable to provide deeper insight into the process of intelligent functioning (all the more reason to look towards biological models of intelligence) (Schmiedek, 2005). The ideas of measuring change are not new, but it has only been within the last two decades that dynamic assessment has come to the fore in the literature (Guthke, Beckmann & Dobat, 1997; Lauchlan & Elliott, 2001). Although not by any means exclusively so, a sizeable research output within dynamic assessment is conducted in the following countries: the Netherlands, Israel, Germany, United States of America, Canada, Belgium, Europe in general, the United Kingdom and South Africa. Research output from South America, Australia and elsewhere is also evident but the mainstay emanates from the first four countries. Dynamic assessment is often greeted with enthusiasm by many practitioners and school psychologists in terms of its theoretical underpinnings and has received attention from many eminent scholars within the intelligence assessment field. Despite the very often positive mentions of this approach it is nevertheless plagued by a number of disadvantages which are similarly highlighted by these scholars; this study being merely one such attempt at providing a framework to aid in guiding the sub-discipline. The most often cited aspect which it is assumed will aid in the theoretical and methodological growth of dynamic assessment is the advent and development of various item response models (Pennings & Verhelst, 1993; Resing, 1993; Schöttke, Bartram & Wiedl, 1993; Sijtsma, 1993a, 1993b) which will go some way in making dynamic assessment more psychometrically sound – perhaps the most criticised aspect of this approach (Minnaert, 2002). These models are based on newer conceptualisations of what it means to validate a construct as well as a move away from the more traditional concept of construct validity[98] as is currently endorsed in some dynamic assessment literature (Carlson & Wiedl, 2000) (more on this topic is discussed in chapter 4). Nevertheless, the current trend within psychological assessment is to view dynamic assessment methods as complementary to mainstream assessment (Büchel & Scharnhorst, 1993; Minnaert, 2002; Resing & Roth-Van der Werf, 2002). In some instances though, dynamic assessment is utilised in an incidental fashion such as serving informal functions within a more traditional criterion and norm referenced manner (Freeman & Miller, 2001). The need to more readily integrate the two methods is called for.

The one common thread specific to dynamic assessment is its role within cultural assessment scenarios (Van de Vijver, 1993), and although not in any way limited to assessments of culturally diverse groups, finds its niche in this context specifically due to the method's manner of assessing for a largely "untouched" construct of ability; i.e. pure ability devoid of cultural influences (Van de Vijver & Jongmans, 2002). Vygotsky's task was one of assessing intellect in a socio-political sphere which denied that intellectual differences existed (Gindis, 1995a; Guthke, 1993b; Guthke, Beckmann & Dobat, 1997) and where ignoring the issue of social class and the reduction of the psychological to the physiological was frowned upon (Gilgen, 2000; Van der Veer, 2000). Yet ironically, this was a time in Soviet history where support for educational psychology, both moral and financial was considerable (Haenen, 2000). This prompted the furtherance of his approach in treating handicapped children by advocating the need to redress the influence of the socio-cultural environment (particularly the adult environment in which the child grew up) in which the disabled person functioned (Gindis, 1995a; Kerr, 1997). His socio-cultural research programme however began to disintegrate during the 1930's and was replaced by the burgeoning of activity theory (considered a branch of Vygotsky's cultural-historical approach) which bespoke of the activities humans were involved in as crucial towards the development and emergence of mind (brain) (Toomela, 2000). Likewise, Binet's task, to assess for and define different levels of ability within different economic groupings in France prompted his manner of assessment. Socio-economic factors play a negative role when

[98] Which has been referred to as a continuum as opposed to an all-or-none concept (Gross, 2002). This reflects the myriad definitions for concepts such as intelligence for instance.

assessing for intelligence, especially in societies which base such assessments on the prevailing schooling (Tellegen & Laros, 1993). Poorer individuals are often less likely to be able to afford better education and so the cycle ensues but the need to identify gifted students within economically and culturally varied populations manifests and the utilisation of dynamic assessment as technique of assessment-intervention is uniquely placed to assist in this assessment of such populations as well (Lidz, 2001).

Feuerstein's need to assess immigrants seeking asylum in Israel (largely an immigrant country) from as far a field as Ethiopia and Morocco also resulted in a the manner of testing now known as learning potential assessment (Deutsch, 2003; Feuerstein & Feuerstein, 2001; Goldberg, 1991; Gutiérrez-Clellen & Pena, 2001; Kozulin, 2002b; Tzuriel & Haywood, 1992; Zeidner, Matthews & Roberts, 2004). Wide-scale disruption within Europe during and after the second world war resulted in the displacement of countless children and adults seeking residence elsewhere where forms of assessment were woefully inadequate in terms of assessing different cultural groups as well with dealing with the added effects of war (Morphet, 1986; Tzuriel, 2001). Learning within traditional and rural Ethiopian culture was propagated largely via means of imitation and observation and was therefore not verbally based (Katz, Kizony & Parush, 2002). Moroccan, Turkish and Surinam immigrants living in the Netherlands have also benefited from dynamic assessments (Hessels & Hamers, 1993) and the pressing need to continue with dynamic assessment research in the Netherlands can be supported by the ever-increasing number of minority groups in this country (Hessels, 2000). Kozulin and Presseisen (1995) differentiate between types of individuals whose higher order cognitive development and mediated learning experiences can effectively be categorised into one of four areas. The typical categorisation for displaced persons' lack of mediated learning experience is due to displacement of some sort and the concomitant lack of developed higher order thinking processes results in the lack of adequate education. It is not difficult then, to understand why dynamic assessment has gained wider acceptance in the countries mentioned above as opposed to countries which still propound mainstream assessment. There is a need to assess minority groupings (Ruijssenaars, Castelijns & Hamers, 1993) who often present with substantially lower levels of cognitive functioning when assessed within mainstream testing situations (Hessels & Hessels-Schlatter, 2002). These attempts can be categorised as culturally sensitive assessments or ecologically more inclusive (Guthke, 1993a; Lidz, 1981), sensitive to not only the culture but also sensitive to deviations within the specific culture. In other words one must pry apart cultural difference (those not in need of intervention but who may be in need of a culturally-sensitive tool) and those suffering from cultural deprivation (in need of cognitive deficit intervention) (Jensen, Feuerstein, Rand, Kaniel & Tzuriel, 1988; Rosas, 2004; Tzuriel, 2000b). Cultural deprivation occurs in any culture and conformance to one culture as evidenced in typical behaviour can be vastly at odds with another culture's normative behaviour (Helms, 1997).[99] Cultural diversity is seen in many contexts as an asset within any intervention (Robinson-Zanartu & Aganza, 2000) and should be capitalised upon, not dismantled and set aside. Emanating from a different culture and having been the recipient of poor mediational learning experience are two very different etiologies of poor performance (Feuerstein, Rand, Hoffman & Miller, 1980). The child who has received poor mediation will evidence blurred perception of reality, be apathetic and withdrawn and their subsequent isolation results in their fragmented experience of the world (Klein, 2000). There is of course also another sub-group of low performers who evidence neurological problems (Swanson, 2000) and so the landscape of poor performance does not represent an even or smooth territory. Cultural deficit typically occurs within a culture; in other words, delayed development as specific to the culture in question using cultural norms against which to judge deficits. This definition of cultural deficit is then not at all similar to the notion of "other culture" deficit according to which one culture is subverted by another. Culture as utilised within dynamic assessment is thus not tinged with biologically inherited differences between cultures but deficits within cultures (Helms, 1992). This is of particular importance within the dynamic assessment approach towards understanding intellectual functioning and veers away from mainstream intelligence work in this regard.

Regarding the more traditional notion of therapy within psychological science, Haywood (2000) has made important and insightful strides in combining cognitive education into psychotherapeutic interventions where many misdiagnosible aspects of behaviour can be seen to emanate from errors in cognitive thinking as opposed to traditionally accepted pathologies of behaviour. Such an interdisciplinary tool can and has proven thoughtful in approaching sub-optimal performance in culturally different populations. This is clearly not the picture presented by those who merely originate from another culture. The latter is deemed very important as it assumes a fully functioning cultural society without the subsequent need to test these cultures via mainstream and largely Western intelligence batteries which more often than not results in bias to some degree (Hessels & Hamers, 1993). The notion that in order to assess non-westerners one needs to treat people as educable mentally retarded (Sternberg, Grigorenko, Ngorosho, Tantufuye, Mbise, Nokes, Jukes & Bundy, 2002) says more about the test scenario and the reigning concept of intelligence than it does about the various test populations! The need to, for instance, differentiate between children with language differences vs. those with language impairment is of concern and is an area specifically attuned to dynamic assessment approaches (Gillam, Pena & Miller, 1999; Gutiérrez-Clellen & Pena, 2001; Pena & Gillam, 2000). Developing expertise is a notion not favoured by an exclusive reliance on Western concepts of what it means to be "intelligenct" or well equipped. Developing expertise is culture-wide phenomena which is difficult to assess with Western testing methods only

[99] In this regard the reader is urged to take a look at table 26.1 p.521 in D.P.Flanagan, J.L. Genshaft & P.L. Harrison (1997). It is interesting that such notions took such a long time to seep through to mainstream understandings of how best to go about assessing for "intelligence" between different cultures.

(Sternberg & Grigorenko, 2002; Sternberg & Grigorenko, 2001c). Language proficiency bias has also posed serious problems especially for immigrant populations (the majority of whom are children) resulting in confusing learning disabled populations with culturally diverse ones (Cole, 1996b). This critical aspect reflects dynamic assessment's concern with distinguishing between cultural difference and cultural deprivation (Tzuriel, 2002) and can be closely interwoven with both Feuerstein's and Vygotsky's conceptualisation of mediated learning experience and higher order thinking processes (Kozulin & Presseisen, 1995). Immediately, the predicates of dynamic assessment can be seen. Research has also shown the efficacy of utilising dynamic assessment within environments catering for mental retardation as opposed to the more classically aligned mainstream assessments (Hessles-Schlatter, 2002a, 2002b). Metaphorical conceptions of intelligence are the preferred analogies within dynamic assessment where the sociological and anthropological contexts are of deep and consistent concern (Campbell & Carlson, 1995). Change directedness occurs in a second-order manner where change is effected from within the individual and is not imposed from without (pouring information into a system versus the deeper understanding of material from within the system).

2.7.1.1 Soviet ideology and Vygotsky's manoeuvrability within the system

As discussed above, depending on who is viewed as the "founder" of dynamic assessment different emphases can be placed on various aspects within the larger movement. The author has decided to elaborate on the times and work of Lev Semenovich Vygotsky [100] (1896-1934) for the following reasons:

- Vygotsky's work is very well known within the field yet one finds in the mainstream literature that his thoughts are merely descriptive of his opinions regarding the zone of proximal development with little elaboration into the reasons behind this thinking
- Understanding Vygotsky's importance for dynamic assessment is better understood when his thoughts are contextualised perhaps more so due to the nature of Soviet psychology's history (Sutton, 1988)
- Vygotsky was the first researcher within this tradition to develop and offer a more systematised approach towards a newly restructured "defectology" in Russia (which had already a long history in the Soviet Union)
- Vygotsky was separated both in place and time from the continental European and American trends within psychology yet his ideas have proved so fertile in these geographic disparate locations (Resing, 1997)
- Soviet psychology[101] often followed its own trajectory on a number of fronts within psychology and education and more often than not had to dance to the tune of the ruling political party (not always the case but often so). Academic and research work was often politically infused with ideology[102] and reflects a substantial difference between the West in terms of intellectual tradition and approach to the study of psychology
- In keeping with the thesis's main emphasis on meta-theory, Vygotsky's work is perfectly placed to better understand the times during which he worked even though some of this ideas are quite modern (Gouws, 1997). The meta-theoretical framework that has been developed in chapter 3 and 4 will not be implemented here but the spirit of the framework will be felt (see chapter 3 for Madsen's meta-theoretical framework)
- The collectivist background from which Soviet psychological science sprung has much philosophically and ideologically in common with a similar notion of collectivism in South Africa even though this has and is undergoing remarkable changes in both countries; it is the historical origins with which this brief section concerns itself
- Vygotsky's ruminations over a "psychological crisis" is similar to one discussed within this study (see chapter 3). Where was and is the discipline headed? Recall that he was not a psychologist by training (he studied law and philology; Cole & Scribner, 1978; Kerr, 1997 and professionally practised psychology for only ten years; Grigorenko & Kornilova, 1997) and so perhaps his views were less influenced by specific context. He was primarily a thinker for whom the area of psychology suited his vision for application (Kozulin, 1990)
- It has been remarked that the research work of Vygotsky and Piaget (and many others besides) was, to put it bluntly, quite mundane when considered today. But this is precisely the point; when one considers that the former was born at the end of the nineteenth century and worked under, at times, rather bizarre conditions and made almost galactic[103] strides in terms of the then current thinking can one and should one hold such individuals to current standards? It seems that much of the literature regards them with due respect but the author has on occasion reasoned away the necessity of having to once again deliberate on the works and times of Vygotsky when there is now well over half a

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[100] Depending on the text available, one will find his name as Semionovich Vygotskii as well as various other renditions. For the sake of consistency the above will be utilised. The same applies to other Russian names.
[101] It has been the author's experience that much of the literature on Soviet psychology is tinged with ill-defined concepts which may be due to the direct translations of works, phrases and words from the original Russian. Sometimes, it is difficult to appreciate the essence of an argument when given in vague conceptions.
[102] The reader must be cognisant of the fact that much of Soviet psychological work remains to be translated and when it is translated is up to the discretion of the particular researcher's interests and perhaps tacit biases. As Wertsch (1981) remarks, Soviet psychology should be understood in terms of its underlying philosophy which can of course also be said of Western psychology.
[103] Some even consider it futuristic, so much so that time has yet to unravel the fullest grandeur of his theory (Robbins, 2001).

decade of research and development in the area of dynamic assessment. The following digression seeks to imbibe the reader with a sense or feel of what it may have been like to inhabit Vygotsky's shoes, at least from what can be ascertained from the literature and to paint a picture of why the man thought as he did given his circumstances. It is always necessary to revisit the past if one is to make sense of the present and this is as true for dynamic assessment as it is for any discipline for in order to more fully understand where we are today, understanding the past is a prerequisite

- Gillen (2000) cogently argues for a closer understanding of what has made Vygotsky as great as he is currently. The article is insightful and has made the author re-consider her position on Vygotsky or at least on her position concerning others' views on him. Notwithstanding the article the brief discussion is still, it is thought, warranted
- The author has been told on occasion that it is never a good reason to conduct research because it is interesting, but the retort to this is that Soviet psychology is unquestioningly interesting and this area of work hardly ever features in course work within psychology, at least not in South Africa. This brief digression will focus more so on the times during which Vygotsky was active more so than on his theory of ZPD per se and will not focus on the many fine issues (phylogeny and ontogeny as well as thought and language issues) within the works of Vygotsky due to space limitations

By way of a very brief summary to Soviet psychology, table 4 below encapsulates the nature of the discipline's path through the period spanning two hundred and fifty years. The trajectory followed throughout the twentieth century will become clearer during the discussion below which focuses on historical impingements on Soviet psychology.[104]

[104] Sahakian (1975) uses " Russian" and the author has used "Soviet". After the dissolution of the Soviet Union, " Russian" is usually used. However for sake of clarity, the author uses Sahakian's (1975) choice.

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Table 4 Placement of dynamic assessment precursors within the broader context of Russian psychological history (Sahakian, 1975)

A cursory glance: Pedology as placed within the broader context of Russian psychological history	
Precursors of Russian psychology	• The Russian enlightenment – chiefly characterised by M.V. Lomonosov (1711-1765) who founded the Moscow University in 1755 and is considered the founder of Russian philosophical materialism • Russian associational psychology – P.M Lyubovsky, who initiated experimental psychology and put forward the notion of associationism as explanation of mental processes (the mind is organised via a process of organisation emanating from the ideas of Locke and James; Harnish, 2002). Binet, in France chose to break away from mainstream associationism thus propelling the study of intelligence towards the direct measurement of processes as opposed to the then current manner of associationist research (Lautrey & De Ribaupierre, 2004) • The revolutionary democrats – materialistic psychology, active in and around the 1860's concerned with issues such as psychology's placement within the broader field of science, its link to other areas of science and the questions surrounding physiological and mental processes • Early experimental psychology – founded by N.N. Lange (1858-1921) who founded one of the earliest psychological laboratories. This period also witnessed progress in personality, general and comparative psychology
The reflex period	• Reflex theory of mental activity – I.M. Sechenov (1829-1905); considered the founder of Russian physiology • Conditioned reflex or classical conditioning – I.P.Pavlov (1890-1936) • Typology – the study of human individual differences and psychological types – B.M. Teplov (1896-1965) • Orienting reflex – E.N. Sokolov who investigated the neural mechanisms of the orienting reflex • Reflexology – V.M. Bekhterev (1867-1927) who influenced Watson but was historically eclipsed by Pavlov • Reactology – K.N. Kornilov (1879-1957) – who challenged and criticised the work of Bekhterev, stressing the link between the physical and mental, hence the reaction of organisms to the environment (biosociological) • Theory of the dominant – A.A. Ukhtomsky (1884-1942) whose work centred chiefly around neurology thus further inspiring experimental psychology
The pedological period	• Pedological theory – P.P.Blonksy (1884-1941) who emphasised the importance of the relation between heredity and environment within child psychology
The dialectical era	• Dialectical materialism (1930-1950) was the main authoritative representation of Russian psychology during the period of test bans. Prior to this movement human beings were considered products of genetic heritage and environmental influences. Education as notion now intervened heavily. This movement was a fusion of German Hegelian and Feuerbachian philosophies mixed with Marxist thought culminating in the primacy of "the social" in many aspects of theories developed during this period • **Sociohistorical or cultural historical development – L.S. Vygotsky, A.R. Luria and A. Leontiev (more on these researchers in the discussion below)** • Formation of psyche as activity – S.L. Rubinstein (1889-1960) who sought and advocated the unity between the mental and the physical; that mental is fully integrated into the physical development of the organism, that human beings change as society changes and that theory and practice should function as a unit • Involuntary memory – A.A. Smirnov and P.I. Zinchenko who viewed involuntary memory as the result of goal-directed behaviour (i.e. learning and retention is aided by the nature of the task and its context)
Psychology in Armenia and Georgia	• Relevant research

Learning disability research ("defectology") features heavily in the history of Soviet psychology (Bauer, 1959; Coles, 1982; Goldberg, 1982) and represents a substantial segment of this psychology. Special education started as early as 1806 where the state supported schools for deaf and blind children and for a period Russia was on par with like-minded Europe (Malofeev,

1998). Biological Soviet psychology for instance kept abreast of the latest written work from Europe in order that they not start to lag behind but this was at odds, at least ideologically, with the reigning Tsarist regime whose philosophical approach to life did not include reductionist models based on Western science (Wundt's work was criticised by both leftist and rightist groups!) Yet, in what can only be considered a fantastic turn around, Russian progress in materialist monism originated and continued unabated during the latter half of the nineteenth century with many decrying Wundt's status as originator of the laboratory tradition which was concurrently being instituted in Russia (McLeish,1975; Todes, 1984). Russian psychology was in no small measure unaffected by research in Europe[105] both before and after the revolution (Kozulin, 1986) and special education in Russia developed rapidly during the 1920's after the loss of resources during the revolution (Grigorenko, 1998). The war resulted in many displaced people having lost out to education, a scenario similar to that experienced by many refugees the world over. The Institute of Defectology opened its doors to the study and treatment of children with developmental delays in 1929. The theoretical work of Vygotsky (who was appointed as scientific leader; Van der Veer & Valsiner, 1991) emphasised the interplay of socio-cultural variables within development (Malofeev, 1998) during which social semiotic mediation bridged the gulf between words and the world (Shotter, 1993; Wozniak, 1996), the linguistic version of tool as mediator being particularly important to Vygotsky (Leiman, 1992; Vygotsky, 1981b). Human consciousness was, for Vygotsky, situated within the social, cultural and historical environment (Wertsch, 1998), for him knowledge is social in origin even if that knowledge remains trapped within one person; it is because of "the social" that much knowledge is created (Brown & French, 1979; Miller, 1989). Sign within semiotics can take on slightly different meanings; for some it is a tool which represents that which is in reality is otherwise unrepresentable (a map of the Kruger Park) and that which is more readily representable (an arial photo of the Kruger Park) (Leiman, 1992; A. Leontiev, 1981). Vygotsky (1978) differentiates between tool and sign (symbolic mediation; Elkonin, 2001), with the former relating to external changes in objects and the latter relating to internal psychological changes effected by mediation. Play was also of particular importance to Vygotsky who stressed the symbolic aspect of it as mediatory tool in which culture is actualised and embodied within language and gestures (Kozulin, 1986; Nicolopoulou, 1993) and during which children could create their own zone of proximal development (Tzuriel, 2000b). The nature of the tie between language and cognition is a contested one with nativists positing a language centre in the brain progressively deployed throughout development and language as a product of a co-constructed process of learning. The relation between language and learning then becomes one of learning language, learning about language and learning through language (Grieshaber & Ashby, 1997). The results of play provide future impetus for the reorganisation of psychological functions in later life (Nicolopoulou, 1993). Vygotsky's method was christened "experimental-developmental" and was a process-based dynamic analysis of child development (Vygotsky, 1978). He fully appreciated the melding of two manners of locating psychology within the broader field of knowledge discovery and acquisition, thus later prompting his concern with the crisis in psychology. The syndrome of disability is defined as a social problem encompassing the individual but not leaving it there (Grigorenko, 1998). Russian defectology is mainly characterised by the following (Grigorenko, 1998):

- Social remediation and rehabilitation in contrast with the "listing" function within mainstream assessment where individuals are screened and systematised
- The replacement of the loss of certain functions by higher mental functions. However, those individuals evidencing less severe impairment are often not accommodated in this approach
- The subsequent individualisation of specific learner problems but an equal disregard for those mentioned above
- Regardless of the specific disability, mediation within the ZPD is fundamental to rehabilitation
- Mental development and disability is conditioned more by the social sphere than genetic heritability

The Soviet 1920's was a decade characterised by intense interest and strides within the domain of child development, an area considered important due to the future socialist stability of the country and is noted by the contributions of Vygotsky, Kornilov, Krakov and Smirnov among others (Kostyuk, 1972). Child education moved from a concern with "learning through doing" to a concern with "creating a person fulfilling the explicitly denied demands of the social and political order" (Bauer, 1959, p.43). The notion of person-in-society akin to Vygotsky's "mind in society" or "mind in context"[106] or "context and cognition" (Lidz, 1991) and "union of the person in situation" (Snow, 1998a) is very evident here and the stress that this notion plays within dynamic assessment is highlighted (Beals, 2000). Two main types of mediation are evident within Vygotsky's definition: metacognitive and cognitive mediation (Karpov & Haywood, 1998). The former deals with the self regulation, planning, checking and evaluation of behaviour and is encompassed within executive processing of the self (a feature heavily regarded within the Feuersteinian

[105] Developmental psychology for instance is an example of a research area in which parallel developments were taking place in geographically disparate areas of the globe with findings in child development being echoed in Piaget's research, Russian developmental research as well as mainstream North American child developmental psychology. These schools emphasised certain aspects in contrast to the other schools, but by and large, major characteristics of the typical child developmental paths were delineated in similar theories and models of development (Super, 2005).

[106] Gillen (2000) points out that Vygotsky never wrote a book entitled "mind in society" and probably did not consider his ZPD notion as terribly important. The fact that much literature contradicts this notion has resulted in the author leaving in this one sentence. One wonders what Gillen (2000) might make of sweeping statements such as Vygotsky being "the most ingenious, prolific and encyclopaedic humanists of our times" (Gindis, 1995b, p.99).

model of instrumental enrichment[107]). The internalisation of socially mediated experiences was brought and cemented into Soviet psychology by Vygotsky and is considered one of the most consistent attributes of dynamic assessment models[108] (Karpov & Gindis, 2000). Vygotsky melded the notion of a plastic brain which could be shaped by the social environment (Van der Veer & Valsiner,1991) so it would be incorrect to over-simplify his idea of a social aspect only in his theorising. Polarising concepts which are not in fact opposed is a key feature within the reconstruction of science and history and is something to be guarded against (more of this in chapter 3). Secondly, cognitive mediation aids in specific skill acquisition that is needed to perform school tasks for instance. Galperin paid particular attention to cognitive processes within learning and was later to develop a research agenda concerning the teaching and learning process and initiated his research in the 1950's which is parallel in time to the original research conducted by Feuerstein (Haenen, 2001). Haywood (2003) goes one step further in his conceptualisation of neo-Piagetian mediation and includes self-mediation as a further goal to the independent development of the individual where the mediator effectively fades away to be replaced by the adequate and sole functioning of the individual (Miller, 2003b).

Grigorenko (2004b) further stipulates four sub-divisions within Russian psychological research, namely,

- *1917-1936*: the period preceding the 1936 State decree of Pedology
- *1936-1950*: the period framed by the cessation of Pavlov's work. It was during this period that many psychologists were accused of cosmopolitanism (working too closely within Western research traditions) and moving away from Marxism
- *1950-1980's*: during which the reign of terror having subsided allowed for cross-collaborations within Western psychologists yet still maintained a semblance of Marxism
- *the current period*: which emphasises tolerance and is in no way impeded by any ideological barriers
- note that all these contextual influences resulted in intelligence research traditions substantially different from mainstream Western models

One can see from what has transpired above how powerful learning and learning disability research was in the Russian psychology programme and how it came to be that later Western thoughts on early Soviet psychology was influential in the development of various strands of dynamic assessment within both the socio-cultural and psycho-educational realm (Lidz & Gindis, 2003). Most cognitive education programmes have as their genesis classroom experiences (Haywood, 2001b) and it is clear where the field of application lies for this manner of assessment. Dynamic assessment can rightly be referred to as a psychoeducational model of process-based assessment (Haywood, Tzuriel & Vaught, 1992). This is in keeping with Feuerstein's three-pronged approach towards child assessment: the scientific theory of child development, the educational aspect of child pedagogy and the ethical understanding of meaning and action within education (Hadji, 2000). Acknowledgement of theoretical educational psychology and school psychology (theory vs. practice) is evidenced in Feuerstein's bridging of the two disparate fields (some may view them as disparate) (Burden, 2000) and his thinking in terms of modifying general intellectual skills as opposed to domain-specific skills which can be traced in this line of thought. Anecdotal commentary has often illustrated the lack of fit between academic studies and the reality in which such skills are supposedly necessitated (Sternberg, 2000b),[109]so in a way, the enhancement of general functioning can be viewed with more confidence. Applying theoretically inspired models in

[107] It has been noted by scholars that Feuerstein does not adequately cite Vygotsky as intellectual predecessor within mediation research as some ideas are clearly very similar to those of Vygotsky (Miller, 2003b) especially with statements such "what are the chances that this child can go beyond himself" (Goldberg, 1991, p.37) harkening back to the level of next development (ZPD). There are however departures from Feuerstein's enterprise and Vygotsky's conceptualisation; acquisition of mediated concepts and cognitive modifiability are different aspects within the respective theories for instance (Moll, 1986). However, one must be mindful of the fact that early Feuersteinian work was conducted within this mode during the 1950's, a period in which most of Vygotsky's work was only available in Russian. It was only to emerge much later (in the 1970's and onward) in English translations (Wertsch & Tulviste, 1992). Nevertheless, there seems to be a general consensus indicating Feuerstein's alignment with Piagetian developmental learning and thinking and Vygotskian appreciation of the importance of social interaction (Falik, 2000). Many research efforts during the 1960's and 1970's across Europe, Israel and the United States had invoked similar alternative concepts towards the study of intelligence without reference to Vygotsky in any event (Guthke, 1992). Perhaps this is an instance of an idea whose time has come.

[108] Vygotsky's work can be considered as work in progress, thoughts on a model but not a fully developed theory. Hopefully though it is not a world-view masquerading as theory (Hunt, 1997).

[109] At present the author tends to agree with a Feuersteinian predilection for enhancing general cognitive skills as it is expected that a domino effect will commence during which skills learned and modified during intervention programmes could initiate a cascading effect or spill-over into other areas. However, for many practising school and educational psychologists reality necessitates a more subject-specific intervention programme. The author has at times wondered about her application of subject-specific skills in the real world and is pleased to announce that although there are numerous aspects of the curriculum that have never been utilised (and probably will never be) the underlying cognitive changes undergone have proved invaluable. Related to the aspect of practising school psychologists and the at times far from perfect surroundings in which they work, models such as mediated learning experience can and have been systematised into a form which is more practical in circumstances demanding more assessments within shorter time span, notable the Mediated Learning Experience Rating Scale (Lidz, 2000a).

practical day-to-day running of intervention programmes within schools is very much in keeping with the spirit of Feuersteinian approaches.

Metacognitive mediation involves parental guidance of spontaneous (natural, everyday, empirical or unsystematic) concepts whereas "scientific" conceptual knowledge (theoretical) is gathered at school via peer and teacher mediation, scaffolding or assisted performance (Karpov & Bransford, 1995; Lidz & Gindis, 2003; Portes & Vadeboncoeur, 2003; Van Geert, 2000) where verbal definitions start to take charge of thought (Brockmeier, 1996). Such scientific concepts need to be taught directly as many instances of what humankind now takes for granted (understanding gravity for instance) is not immediately apparent. Although the authors add that learning scientific concepts (Vygotsky's terminology) should be a constructed experience (Karpov & Haywood, 1998). In the 1920-1940's unrealistic demands were often made by the state to push delayed children into mainstream education, often resulting in innovative methods of attacking the problem. A major aspect to come from this state of affairs was the need for remedial education and the accompanying need to differentiate those children who merely required teaching in another mode versus those who truly required specialised interventions. Unlike Western psychology which is a testimony to fragmentation (which is not necessarily a negative feature as much good research has come of it), Soviet psychology progressed along smoother lines in terms of trajectories and traditions although there is also no such notion as "Soviet psychology" just as there is no such thing as "American psychology" (Hydén, 1988; Valsiner, 1996). The era during which Vygotsky lived witnessed relatively few traditions within Russia which was of course to change later on (Van der Veer, 2000). This trend was aided by the effective ban for 25 years on the practise of psychology as a discipline as well as a ban on sociological surveys (Malofeev, 1998). School psychologists were effectually eliminated in 1936 and were only reinstated more than 40 years later (Grigorenko, 1998) due to the prevailing spirit of equality of all and the subsequent placement of all national groups under one Soviet Union (Tzuriel & Haywood, 1992). Concerning the banning of tests in 1936, Jarovsky (1989) highlights the differing interpretations of intelligence as viewed in Soviet society and American society during the first half of the twentieth century. Americans, he states, were concerned with the nature-nurture debate due to their "dream of purely achieved status" and being anxious to improve upon techniques of further justifying inequality whereas Soviets aligned themselves with the idea of upward mobility in terms of intellectual recognition. People in the lower strata of societal functioning were not placed there intentionally and "great talents were imprisoned within the uncivilised" (p.346). Nevertheless, three main Soviet traditions can be identified:

- Pavlovian psychology (akin to Skinnerian behaviourism) – in which the beginning of the subject domain of higher nervous activity was presented in 1903 at the International Medical Congress in Madrid (Brožek, 1972b; Ushakova, 1997). This research tradition is of particular importance regarding the cross-pollination of ideas *from* the Soviet Union *to* the West and Pavlov's influence is evident in the works of both Russian and Western researchers such as Bekhterev, Anokhin, Asratyan, Thorndike, Yerkes and Watson (Kozulin, 1986). Although the influence of Pavlov is well known, it must be noted that the development of behaviourism and "objective psychology" did occur more or less simultaneously, Pavlov's work was pre-revolutionary (Bauer, 1959) and was influenced by (some would claim was based upon) the work of others including Sechenov who is considered the father of Russian physiology (Gilgen & Gilgen, 1996; Sahakian, 1975). Soviet psychological science's past is an historical inventory of physiology as well as mental studies and the two have often become so melded that the one (mental studies) seems to have been subsumed within the physiological counterpart (Zinchenko & Gordon, 1981). In keeping with general philosophy of science issues then nascent within Western psychology, reductionist understandings of human functioning must have been a welcome addition to the repertoire within research, although this research tradition has, within the Soviet Union, been considered the domain of physiology as opposed to psychology (Brožek, 1966, 1972a; O'Connor,1961). It is difficult at times to draw a distinction between various research domains under the blanket term of physiology or psychology (Bauer, 1959). Pavlov acknowledged the inner life of subjective consciousness but understood that objective research within this domain would prove problematic (Ushakova, 1997). Eminent Soviet psychologists both endorsed and applied Pavlov's research tradition. American behaviourism generated much output during the 1930-1950's and was heavily influenced by Russian reflexology (Brennan, 1982) more so by Bekhterev and Sechenov than Pavlov in fact (McLeish, 1975; Valsiner, 1988), the latters' work and influence often being overemphasised. Vygotsky deliberates upon the consideration of thought as pure reflex and discusses the role of mediation as an observable means to reach unobservable thoughts (Vygotsky, 1994b).[110] Biologically conditioned responses as well as historically derived (cultural) responses are part of the developing child's repertoire of skill and skill acquisition (Vygotsky, 1994e) but the main focus within his pedological work was not with the laws of heredity as such as much as the role that such

[110] Although the author does not read Russian and has had to rely on translations of Vygotsky's works from various translators, it is evident that his style is quite lyrical and flowing which, from an aesthetic point of view, is refreshing but can be a bit tedious when trying to get to the crux of what he is trying to say. One finds that when reading a passage on subject *x* that he seems to take quite a while in getting to the point. Cole and Scribner (1978) point out that his style is general and almost no raw data is ever presented. But in all fairness, Vygotsky was a pioneer on a number of fronts and it would be unwise to be overly critical of his work from the stand point of a century in the future. Nevertheless it is a unique style and at times so lucid in thought in terms of the fusion of biological and environmental concerns that the author feels almost as if Vygotsky would have been quite comfortable bridging the psychological with the physiological as has been alluded to already.

heredity plays within development (Vygotsky, 1994f). This rich area of research seems to have dominated branches of related research into perception, memory and brain plasticity. However, just as there are gaps evident in the theory and models of Piaget so too are there gaps in Pavlov's work (but there would be, it is over a century since his Madrid presentation)

- Abstract mental operations analysis research best exemplified by Rubinstein (akin to structuralism and Gestalt psychology) who sought to turn psychological experimentation in the Vygotskian sense into a more educational one in keeping with Marxist philosophies of active change (through change one is able to come to greater understanding of objects in the world and the way to obtain knowledge about objects in the world is to set about attempting to change them) (Guthke & Wingenfeld, 1992; Lidz, 1991). Ironically, Rubinstein's work was considered too bourgeois in the 1940's which resulted in his revising his work and turning towards the Pavlovian tradition of ideas (Hydén, 1988). There is continuous flux between genetic and environmental heritage, a process to which the developing child has to grow accustomed. There is also the social which services the internal via mediatory agents such as adults which guide the growth of children. A departure from Western thought on the matter of age-dependent maturation occurred with the likes of Rubinstein's questioning of the nature of this growth which is dependent not only on age but on the information accumulated by children as well as the nature of their varied activities (Kostyuk, 1972). Vygotsky himself differed with Piaget on the matter of pure age-related growth stating that development and instruction were commensurate and integrated in such a way that instruction and development co-occur. Hence his theoretical offering by way of the ZPD to this question (Allal & Ducrey, 2000; Karpov & Bransford, 1995; McLeish, 1975; Van der Veer & Valsiner, 1991) added to the notion that development does not necessarily lead to learning (Feldman & Fowler, 1997) in a straightforward information processing fashion (Gindis, 1995b). For instance, no matter how mathematically gifted a child is, no manner of improvement or regard for mathematical concepts will be forthcoming unless there is adequate mediation on the part of some social force (Vygotsky, 1994f). It is necessary to differentiate between organismic developmental stability across cultures due to common genetic ancestry and variant changes brought about by learning in different cultures (or set-ups and schooling environments). Learning and development co-occur and this means that variant changes in development are due to learning environments (Niaz & Caraucan, 1998) an aspect underappreciated by Piaget but closely seen to by Vygotsky and also by dynamic assessment's concern with the learning-to-learn approach. In this regard, due deliberation is given to both developmental and learning issues within modern theories of cognition (Niaz, 1998). The training of skills via instruction has become prominent in the literature since the early 1980's (Borkowski & Konarski, 1981). Vygotsky (1978) referred to this method of development observation as instrumental and noted how erroneous it was to insist on the separation of the two. For instance, to study the child regardless of the environment (reminiscent of Binet) is characteristic of a natural endowment approach versus the study of achievement due to the environment only, regardless of the natural processes at work is to miss the vital link of the interaction between natural ability and environmental concern (Vygotsky, 1981a). "Child development is least of all like a smooth process sheltered from external influences" (Vygotsky, 1981b, p.151) and the case is vividly illustrated in his testimony of the deaf child's development which may be delayed only due to the lack of an appropriate environment and that this delay is far from being one of genetic causality (Vygotsky, 1981c) and should be dealt with as a social problem. He did not of course deny the problem's biological nature[111] (Vygotsky, 1994a). He was keenly appreciative of Darwinian theory[112] (as was the whole enterprise of the study of child development as geared towards a materialist-evolutionary concern for the field; Rahmani, 1966). He sought two lines of human development as explanatory modes of human social existence; the first detailing biological evolutionary adaptation and environmental press bringing about inclusive fitness and the social or historical development, upon which he seemed to place more emphasis and its regulation of the further development of "socialist man" (Vygotsky, 1978, 1994d). The importance allotted to instruction and development as co-occurring aspects within his theory is echoed in current dynamic assessment efforts as well as Feuersteinian theory which is principally instruction coupled with assessment (Messerer, Hunt, Meyers & Lerner, 1984)
- Vygotskian cognitive developmental psychology (akin to the later Piagetian and Feuersteinian developmental and contextual approaches). It is noteworthy to consider Van der Veer and Valsiner's (1994) three reminders about Vygotsky's work which they consider to be blind spots;
    - although the Soviet Union did experience isolation, both academic and social particularly during the reign of Stalin, Vygotsky's thoughts can nevertheless be considered interdependent with European and American academic thoughts and this can be seen in some of his work (Porges, 1998; Vygotsky, 1978)
    - Vygotsky, although emphasising the socio-cultural context, did in fact place a great deal of emphasis on the individual developing person

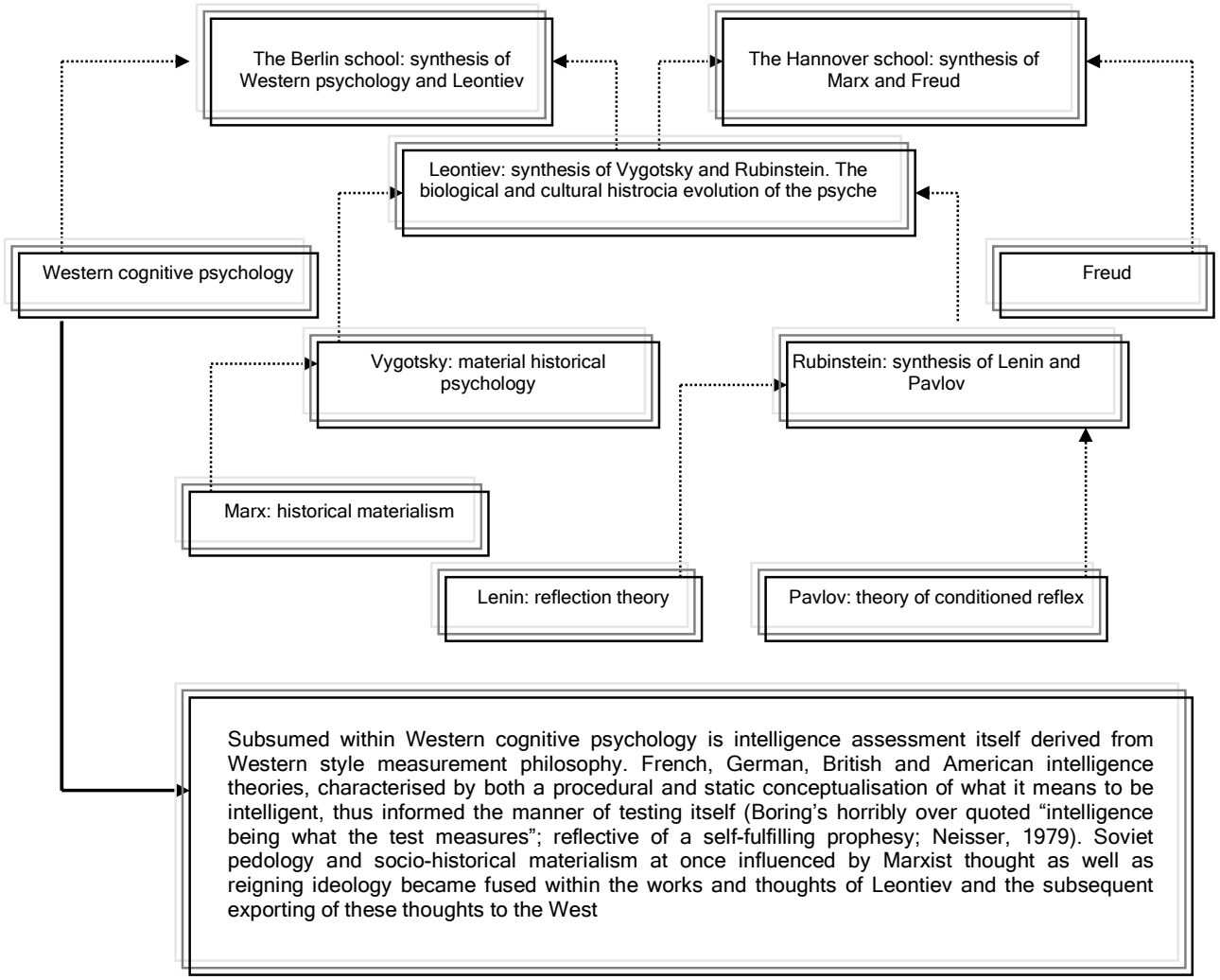
[111] This makes for the interesting slotting in of dynamic assessment models and theories within intelligence assessment where intelligence is itself defined from distinct vantage points; from neural mechanisms to social processes (Lohman, 2005; Pretz & Sternberg, 2005).
[112] No longer considered a theory but a fact yet at the time of Vygotsky and his contemporaries, public opinion was divided (unfortunately a similar divide seems to forever seethe under the surface when it comes to public opinion).

- Vygotsky's emphasis lay more heavily on the cultural aspect of social mediation (cultural experience, cultural behaviour and cultural methods of reasoning; Vygotsky, 1994c), more so than on individual peer and teacher mediation. "Culture, generally speaking, does not produce anything new apart from that which is given by nature. But it transforms nature to suit the ends of man" (p.59). Also, peer, parent and teacher mediation has often been cited in positive terms where functioning within the zone of proximal development is considered advantageous, but is this the case in all instances?

Marxist philosophy on the theory of society is an underlying and prevalent feature of these three approaches but widely disparate in their efforts as separate traditions (Coles, 1982; Shotter, 1989). The case of ideology has at times been critiqued for being overstated and oversimplified in some literature (Bauer, 1959; Doehring, 1982; Valsiner, 1988). Such oversimplified renderings of Marxist thought can, at times, be misconstrued as a mechanistic treatise for socialist life which it in fact is very much not (Joravsky, 1989). Yet reading the literature generally leaves one with the impression that many aspects of Soviet academic thought including Vygotsky's ideas on consciousness and cognition were traced along lines of a division of labour (Emihovich & Lima, 1995; Moll & Slonimsky, 1989).[113] As O'Connor (1966) points out, much of Soviet psychology has been oriented by dialectical materialism; a period lasting from 1936-1950 (Sahakian, 1975). One rarely reviews Russian/Soviet psychological literature without noting Marx's contributions in some form or another (Avtonomova, 1995). Figure 8 illustrates the linkages between various thoughts maintained by philosophers and psychologists within Soviet psychology.

[113] As Emihovich and Lima (1995) point out, Vygotsky differed from traditional Marxist renderings of labour where the focus was on the mastering of nature via tools as opposed to the mastering of cognitive processes via psychological tools.

Figure 8 Linkages between schools of thought with emphasis on Soviet systems (Madsen, 1988, p.444)



That this background somewhat intrudes on pure and objective research is often viewed with scepticism by Western intellectual counterparts (Gray, 1966). However, such political dominance and resulting influences cannot be understated such as after the 1917 revolution where anything which smacked of bourgeoisie tendencies was literally obliterated before it could raise its head. There is of course the understanding that among many Soviet psychologists, theories and implementation of ideas were voluntarily moulded by Marxist ideology with many advocating its necessity, so it would be incorrect to state that such ideology was pervasively forced upon academics (Cole & Cole, 1979). Joravsky's (1989) definition of ideology as pertains to Soviet psychology is decisive in its depiction of the state of affairs "[an] unacknowledged dogma that serves a social function of unverified belief assumed to be proven truth because they serve the interests of the group that shares them" (p.ix). During the latter half of the nineteenth century, some psychological articles were infused with a mixture of science, ideology and politics (Grigorenko, 2004b; Grigorenko & Kornilova, 1997; Todes, 1984) and the intertwined nature of science and society was never more marked than after the 1917 revolution in which psychological studies focused on the individual in socialist society (Valsiner, 1996).[114] It has even been extolled that Soviet psychology originated within the realm of political action and not in the laboratory (McLeish, 1975) but the role played by reigning ideology cannot be discounted when considering Soviet psychology

[114] A lengthy citation from Todes (1984, p.544) construes this situation perfectly: "The records of the St. Petersburg Censorship Committee testify to the basic antagonism between developments in biological psychology and Tsarist ideology. Perhaps more important they indicate that because the Tsarist state was unwilling to halt development of science and medicine it was compelled to acquiesce to the gradual erosion of a critical feature of official ideology. Several factors, particularly the rise of professionalism and positivism, limited the rate of that erosion, and biological psychology could not, of course, disprove the concept of an immaterial 'spiritual aspect of man'. Yet ideas can be defeated by simply being ignored, and the increasing legitimacy of biological psychology in Russia did provide alternatives to the traditional explanation of human psychology. In this sense, the fears of the Tsarist censor proved well-founded, and biological psychology displaced a key element of Tsarist ideology within an ever-widening sector of Russia's intelligentsia".

(Oleinik, 1996).[115] The rallying call of "all like one, one like all" is evidence of the nature of the times in which retarded children's education was ignored (Malofeev, 1998) and the task of creating a homogenous society without class distinction was very much part of the socialist nation ideal (Kozulin, 1987).

One cannot unequivocally state that Western psychological traditions are typically individualistic even though there is an identifiable trend witnessed in these various traditions. It has always struck the author as odd that although Vygotsky adhered to Marxist philosophies (he was a leading Marxist theoretician; Luria, 1979) and sought to reform psychology by integrating Marxist thought within his approach to child assessment, his novel approach was effectively banned in the Soviet Union (Cole & Scribner, 1978; Kozulin & Presseisen, 1995; Yaroshevsky, 1996). "To look at Vygotsky's book *Pedagogical Psychology*, one had to have a special pass from the KGB that would admit one to the restricted reading room in the Lenin library where the book could be read" (Davydov, 1993 in Kerr, 1997, p.4). This should give one an idea about the period and circumstances during which Soviet psychology was being developed.[116] During the 1930's both Luria and Vygotsky's work was a blended version of Soviet and Western psychological ideas, seeking to utilise what both traditions could viably offer (Joravsky, 1989). Luria's pioneering ethnographic work in Soviet Central Asia preceded work conducted within anthropological studies in the United States (Hunt, 1994). McLeish (1975) offers two reasons as to his unpopularity by stating the lack of sufficient Marxist quotes in his texts and his affiliations with pedology (the general all-round study of child development; Sutton, 1988) and hence testing. There is no such thing as a Marxist psychology even though it is in some instances referred to as such (Madsen, 1988), for Marx never developed such a system but did remark on questions of psychology (Rubinštejn, 1987). There was a fervent attempt at creation of Marxist dialectical materialist psychology (Hydén, 1988) and science in general (Tobach, 1996). Ageyev (2003) in one of the more user-friendly articles on Vygotsky does an admirable job of highlighting various difficult issues that Western students face when reading Vygotsky. Marxism and its related philosophy is not the mainstay of Western education and the connection with Vygotsky is often strange to some. Why were Soviets so immersed in this philosophy? Ironically, states Ageyev (2003), Vygotsky is often decontextualised which goes against the grain of his cultural-historical theory! Much of Soviet history is indeed perplexing especially when seen in the light of favourable and unfavourable art, music, dance and theatre and cultural life in general where state approval was often the precursor to success. Trends and governing regulations were often fickle with many Soviet artists (musicians and dancers for instance whose works were considered atonal, naturalistic or cacophonous were discouraged; McLeish, 1975) and scientists becoming blacklisted almost overnight for some supposed transgression which supposedly reflected the State in a bad light. Goldberg (1982) casually refers to this state of affairs as not atypical and to be accepted as part of Soviet history. Brožek and Slobin (1972) claim that Vygotsky was the first Russian psychologist to depict, in entirely psychological terms, a Marxist account of the socio-historical nature of human consciousness and adhered to a dialectical materialist account of psychology which can briefly be described as:

- Subscribing to materialist monism (mind is brain, see above section on consciousness)
- Determinism (the interests in biogenetic studies of development was a characteristic of 1920-1930's Soviet psychological science)
- Reflection (consciousness is a reflection of external reality)
- The unity of consciousness and activity (consciousness as formed by the activity in which one engages)
- Historicism (the development of consciousness out of human history)
- The unity of theory and practice (theory is only as good as its application in practical contexts usually in educational, child, work psychology as well as psychopathology; Teplov, 1961)

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[115] Of course very much the same can be said of Western psychology which is similarly a product of capitalism and individualism (Eskola & Weckroth, 1996). One need only think of the appeal of pop psychology where you are made aware of a problem you do not have only to be offered the solution for half the price of the competitor!

[116] Vygotsky's ideas and theories were developed during particularly hazardous times with major events during 1917 - 1928 being characterised by civil war, "desperately poor conditions, famine, the forced exile of some intellectuals, …a struggle to eliminate all aspects of bourgeois society….[as well as the rise of dialectical Marxism] that accompanied the assumption of power by Stalin" (Gilgen & Gilgen, 1996, p.9). The period from 1928 till his death in 1934 coincided with the Stalinist Era during which psychology (like may other fields of scientific inquiry) were systematically "purged" of unwanted and undesired suspected bourgeois influences. Science in early twentieth century Russia witnessed "explosive institutional growth [which] was accompanied by the abolition of entire disciplines, and outstanding achievements routinely co-existed with backward doctrines" (Krementsov, 1997, p.777). Vygotsky's ideas were not immune to these intellectual and brutal purges either and did not exist in a socio-political vacuum. Psychologists, who during the 1920's, did not affiliate themselves with the ideals of Marxism as espoused by Stalin, were simply not allowed the freedom of continuing their research (Kozulin, 1990) and those who did not follow Marxist dictates were either exiled or subdued (Grigorenko, 2004b). Furthermore, Kozulin states that Vygotsky (among others) did not escape criticism and that his "cultural-historical theory was branded as leading to an anti-materialistic revision of psychology and [was] considered to be a reflection of bourgeois inclinations" (p.240). Without going into dire detail, Vygotsky's plight is seldom the focus point in the many articles and books that discuss his work, but is thought of here as primary importance in the development of dynamic assessment as it pertains to his particular bent on semiotics and socio-cultural aspects of child development. Such socio-cultural and political influences cannot be ignored when considering a study such as this proposed one. Another point to consider is the effect of prevailing models of assessment ca. 1920 and to what extent Vygotsky and others were influenced by them (if at all, as Russia was quite isolationist at this time in terms of scientific progress and subsequent publication of scientific results in general).

One can clearly follow a thread in Vygotsky's thoughts regarding the utility of dialectical materialism. The focus on external impinging social reality in the formation of consciousness, the notable influence of historical processes in the development of mind (brain) and his application within pedagogical or pedological contexts. Interestingly, the above accords with similar notions as advocated within a positivist framework which has indeed been remarked on (Bickley, 1977). Such positivist interpretations were encouraged during Stalin's reign but rigid and unwavering adherence to strict positivism where objective facts were assimilated without being processed actively by the individual was anathema to Vygotsky (Van der Veer, 1996). One needs to tread carefully over the terrain of reigning popular conceptions of Soviet psychology and the movements within and around it by individual researchers. Bauer (1959) distinguishes two types of Marxism, which can be read with the above in mind, namely, a "vulgar Marxism" which affirms a popular rendering of the common understanding of Marxism which concerns itself with materialism, mechanist and deterministic understandings of behaviour and the second understanding of Marxism which is a more reflective one in the understanding of consciousness and the processes involved in active perception all the while acknowledging a separate yet extant reality. The conflict between the two conceptions played out in areas other than Soviet academia. The see-saw notion one gets from reading the history of Soviet psychology is likewise attested to in the works of various Soviet psychology scholars. Certain theorists and researchers work was considered acceptable only to be termed unacceptable later on and is indicative perhaps of the complicated role played by ideology and how academics and others had to manoeuvre within the system. One of the key features in common among the group of researchers led by Vygotsky, was the emphasis on practical applicability and the development of a psychology in practice and is exemplified in the works of, among others, Vygotsky's own research with handicapped children, Luria's studies of twins, Leontiev's study of school children's concept formation development, Zaporozhets' work into child mental development, Galperin's studies of the manner in which tools were mastered by children and Zinchenko's work in memory (Zinchenko, 1982).

Vygotsky's ZPD stands in stark contrast to the *g*-centred research in mainstream assessment and the almost natural urge among mainstream assessors is to try and quantify a concept which seems to lie beyond such an attempt (Ageyev, 2003). However this is precisely the problem within current dynamic assessment: the need to quantify and model change. The author often wonders whether Vygotsky would not turn in his grave if he were to witness such flagrant disregard for a process wholly entrenched in qualitative assessment.[117] However, Vygotsky himself did not conduct any experimental validation of the ZPD in his own short life-time leaving it open in a sense to future adaptation and experimentation (Sternberg & Grigorenko, 2002). Perhaps the need to quantify the ZPD is another symptom of mainstream assessment. Vygotsky's ZPD was only "recently" researched for the first time in American literature in 1964 (Das &Conway, 1992) and was brought to the fore in this country in particular by Budoff and his team who were among the first to apply Luria's modified version of Vygotsky's ZPD (Hamers, Hessels & Pennings, 1996). The beginnings of *g*-related research had ignited following Spearman's seminal paper in 1904 so Vygotsky would most likely have known about it. ZPD is fundamentally a language-centred socio-cultural theory of development and the main proponent of such theory is A.N. Leontiev, a Soviet theoretician who argues that the individual changes qualitatively through life, being influenced by social and economic factors (Alfassi, 2002; Coles, 1982) and is not set by biological heredity (Kostyuk, 1872). Vygotsky's ZPD is illustrated in figure 9 below.

[117] He could also possibly be overjoyed at the strides made within psychobiology. Who knows?

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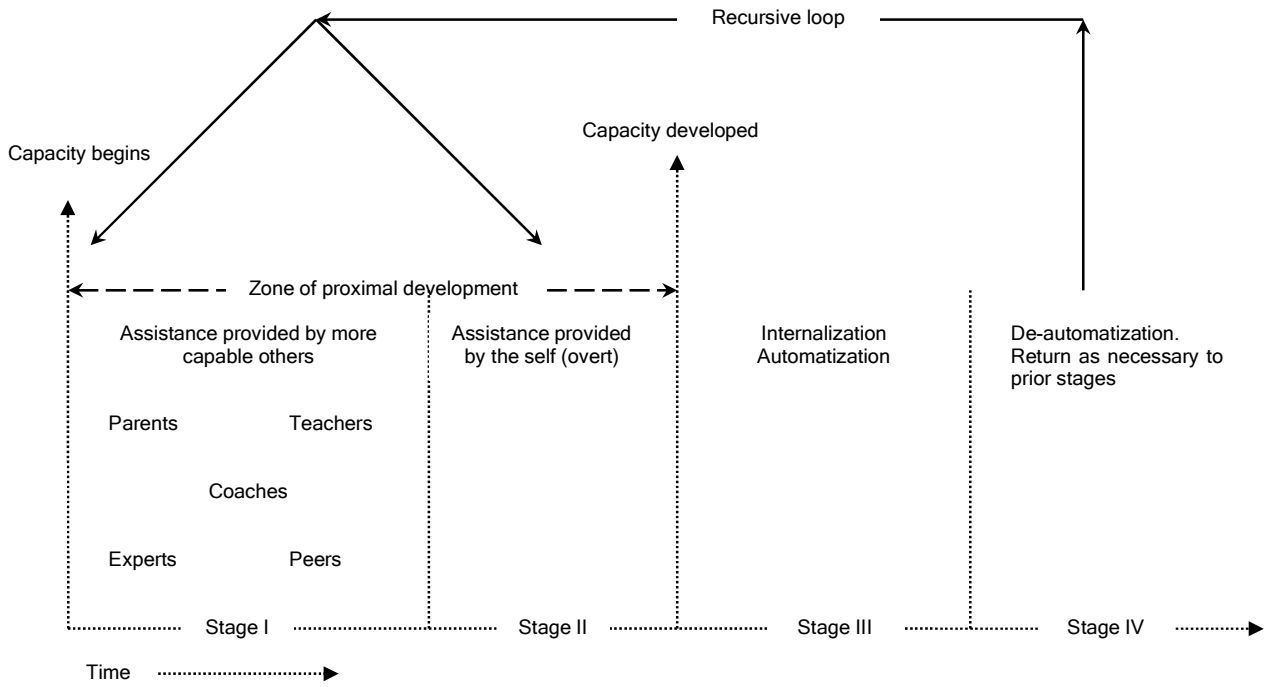
Figure 9 Tharp and Gallimore's (1988, p.35) depiction of Vygotsky's zone of proximal development



He speaks, too, of original learning as being chiefly characterised by responses to environmental stimuli much in keeping with the Pavlovian tradition (Leontiev, 1961). Leontiev criticised Western tendencies for describing psychological reality as a registry of functions without context, as the best experimentation occurs outside laboratory settings (notwithstanding the obvious severe set-backs) (Shotter, 1989). This is in keeping with current disability research which promotes the understanding of disability within the real-life situation (Grigorenko, 1998). Along with Vygotsky and Luria, Leontiev contributed to what was later to become cultural-historical activity theory (also founded upon principles of dialectical materialism; Sheng, 1996) which is self explanatory in terms of its power as an implementable tool (Hydén, 1988; Lee, 2003). Although his theory can be viewed as an extension of Vygotsky's, there are elements within Leontiev's theory which are not present in Vygotsky's (Hydén, 1988) and his deliberations on the concept of activity was the more generally accepted one (Wertsch, 1981).

Later, followers of Vygotsky replaced the idea of semiotic mediation with that of activity theory where practical actions took precedence in theory and research (Robbins, 2001). Vygotsky, although never acquiring theoretical status in his theory, used the term activity largely to denote a process of being engaged in something or simply being active (Hydén, 1988). Mental processes are the direct result of human activity. The notion of labour is particularly evident here and hence its link to Marxist philosophy. Soviet psychology took pains to mitigate the effects of capitalist notions within its own developed "labour psychology" (Guthke &Wingenfeld, 1992; Kotelova, 1972; Noskova, 1996). It is through such activity that learning occurs and is very similar to the Piagetian notion of learning by engaging with reality (Das & Conway, 1992). Activity or labour was so fundamental a concept during the early decades in Soviet psychology that even the realm of emotions was considered most amenable to study when viewed from a labour point of view (man at work becomes equated with his emotions) (McLeish, 1975). Marxist concern with equality of distribution and the resulting perplexity by members of more capitalist societies is perhaps one reason why such early dynamic assessment models were anathema to Western countries (Rand & Tannebaum, 2000).[118] Vygotsky has thus been referred to as a meta-psychologist and for very good reason (Kozulin,1986; Robbins, 2001, 2003). Of course one must take cognisance of the parallel developments within the West at this time where individuals were studied so as to better understand them not always necessarily to help them. Vygotsky's idea that thinking was dialogue transferred is superbly rendered within a social system where the individual becomes such through others (Shotter, 1993) and it can clearly be seen how such mediated learning was to become such a prime concern for Feuerstein later on. Individual consciousness becomes secondary in the transmission of social consciousness and his ideas are similar to those of G.H. Mead and are

[118] There is a slight clash of ideology but surely can we not say that dynamic assessment has moved on since the early conceptions of its being polarised due to its "collectivist" leanings? Westerner's no longer have as their excuse the misunderstandings of he basic philosophy behind dynamic assessment and likewise, non-Western countries cannot forever lament the West's preoccupation with individualism, after all, the world is progressively globalising.

traceable to the works of French psychologist Pierre Janet who in turn was influenced by Emile Durkheim and the French sociologists (Cole & Scribner, 1978; Kozulin, 1990; Nicolopoulou, 1993; Van der Veer & Valsiner, 1991; Vygotsky, 1981b; Wertsch & Tulviste, 1992). Janet's concern for the "other" within development seems to have influenced Vygotsky's thoughts in this regard (Kozulin, 1986) but Vygotsky was the first psychologist to introduce the aspect of culture into the study of the nature of being human (Cole & Scribner, 1978). The Gestalt movement and its appeal to holism found a receptive audience generally in Russia at the time and with Vygotsky specifically (Van der Veer, 1996), which is hardly surprising when one considers the manner of the Gestalt approach to perception as opposed to behaviourist approaches. Among other Western psychologies, Vygotsky also critically analysed the works of Piaget, personalism and behaviourism (Brožek & Slobin, 1972; Kozulin & Presseisen, 1995). However programmes such as Gestalt psychology and psychoanalysis[119] was deemed bourgeois (as well as departing quite radically from "objective psychology" characterised by Pavlovian and Bekhterevian psychology; Wozniak, 1996) and so not appropriate for study, resulting in the later unfashionable Vygotskian school which was all but abandoned for many years (Guthke, 1982) until it became fashionable once more around 1956 after the death of Stalin (Kozulin,1986; Toomela, 2000; Van der Veer & Valsiner, 1994).

This abandonment can perhaps best be understood with Vygotsky's programme being labelled anti-Marxist and bourgeois. However the further one delves into the reasoning behind this successive banning and resurgence of his work the more difficult it is to understand. Leontiev and his research group, for instance, aligned their theory more in keeping with the 1936 communist party decree stating that pedology (educational psychology) should be banned.[120] This was most likely to do with the assumption of equal intellectual endowment in children; a means of moving away from a class society so despised by Bolshevists (Gilgen & Gilgen, 1996). It was maintained that it was on the labour of the masses that society prospered and not on the intellect of the intelligentsia but there were also other reasons why Stalin has chosen pedology as part of his purge policy.[121]

The social determination of thinking had as a result educational thoughts on development assuming socially mediated learning representing complete development (Grigorenko, 2004b) which of course did not manifest. Nevertheless, Gindis (1995a) maintains that an objective history of pedology has yet to be written. There was thus a turn away from previous pre-soviet physiology to a more inclusive social psychology (Bauer, 1959;[122] Koltsova, 1996; Vasilev, 1996). In effect the decree meant the following (Abulkhanova-Slavskaya & Brushlinsky, 1996; Bauer, 1959):

- The school psychologist's activity was to be drastically reduced in scope and activity with the subsequent increase in status of the educator in matters psychological
- No more testing was to be allowed
- The expurgation of the study of personality
- Industrial psychology was similarly disbanded
- The concept of man was now more purposive and conscious
- Training was to receive more emphasis as opposed to the role played by the environment (the latter which Vygotsky and those before him emphasised)
- The task of psychologists was to churn out socialist citizens as opposed to laying emphasis on the biological being's interaction with the environment (one can see how Vygotsky's programme came under severe limitations)

This played out in the subsequent banning of such tests in East Germany at the time as well as the subsequent disappearance of intelligence tests in China following the goings-on in the Soviet Union and the later cultural revolution in China[123] (Guthke &

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[119] The Russian psychoanalytic society was in formation during 1923 and Stalin announced certain abandonments of psychology in 1929 (Santiago-Delefosse & Delefosse, 2002).

[120] Incidentally, the Tsar banned the teaching of philosophy in 1850 (Joravsky, 1989). One cannot deny the influence of ideology on current academic and psychological thought. This played out in Vygotsky's thoughts on child development to a point and he was, even though ahead of his time, still a product of it.

[121] Stalin's son, Vasily, could not pass pedology tests apparently! (Gindis, 1995). So perhaps Stalin's reason was partially motivated by this.

[122] Life under Stalin was progressive in one sense (the nationalisation of various aspects of the economy - the five year plans - and the distribution of resources to far more people than during the reign of the Tsars; Solso, 1996) but equally wrought with paranoia and suspicion. America's "reds under the beds" syndrome seems to have echoed Russia's early "comrade today, threat tomorrow" syndrome. What becomes of science and scientists during such hectic times? Unfortunately, they are most often the ones to "disappear". Vygotsky died of tuberculosis but one cannot but help wonder about conspiracies! After all, Bekhterev was poisoned by Stalin's assassins in 1927 (Medvedev, 1996) and Bekhterev considered Stalin paranoid (Joravsky, 1989) seemingly with good reason. In fact Sabina Spielrein's father and brother were both arrested for deleterious pedological research and her brother was subsequently executed as a Trotskyist (Santiago-Delefosse & Delefosse, 2002). Stalin chased Trotsky all over Russia giving him no rest until he finally assassinated. Likewise, psychologists who were deemed as encouraging anti-regime notions could be sentenced for Trotskyism! (Bauer, 1959). To boot, Trotsky was considered an advocate of bourgeoisie psychoanalysis, as well as an opponent of materialism and Marxism (Tugaybayeva, 1996).

[123] Large-scale group administered tests were also banned in Israel in 1985 as passed by the Ministry of Education, following what has now become known as the "anti-test syndrome"; protests surrounding the use of assessment tests for placements in schools (Zeidner, Matthews & Roberts, 2004). During the Second World War, the use of educational tests was minimised in Japan following on from a viewpoint which stressed that individuality as a concept should be eschewed (Sato, Namiki, Ando & Hatano, 2004). Problems surrounding tests and their administration are thus not limited to only a few countries at certain time periods but hve been an omnipresent issue throughout the ages.

Beckmann, 2000a; Shi, 2004). This is perhaps a contributory reason why dynamic assessment or the learning-test concept took hold in Germany as strongly as it did (Kormann & Sporer, 1983). There was a strong current and flow of ideas between the former East Germany and Soviet Russia; ideas which were not necessarily transported to the West (Robbins, 2001; Woodward & Clark, 1996). The works of Western psychologists were originally translated into Russian but were increasingly filtered so as to guard against ideological contamination (Joravsky, 1989). Soviet psychology journals were likewise banned for 23 years and were officially declared acceptable only in the 1950's after Stalin's rule. Even the major journals ceased publication from 1932-1934 and publications remained sparse until 1946 when serial publications of the Academy of Pedagogical Sciences was inaugurated (Bauer, 1959). Leontiev's emphasis on socio-historical Marxist influenced approaches towards human behaviour moved away from Vygotsky's original concern with sign within culture. Although it is possible to identify Marxist feelings within Vygotsky's work, he criticised others' works for abusing Marxist writings and inappropriately attempting to integrate Marxism into their work (Robbins, 2003). In fact so tumultuous were the times that Luria most likely changed his research direction from psychoanalysis to clinical neuropsychology due to its distastefulness.[124] Luria's extensive work in neuropsychology has had much influence in the discipline today and intelligence models have been based on his research into brain malfunction; one need only think of the Das and Naglieri model of the assessment of attention, simultaneous-successive coding, and planning (Angus, 1985; Das, 1998; Das & Naglieri, 1992; Das, Parilla & Papadopoulos, 2000; Naglieri, 1997). Vygotsky's work has indeed seeped through to a very deep level in the West at a time when the Soviet union had all but banned Western scientific literature and severed ties with Western academic counterparts (Valsiner, 1988).[125] Vygotsky's work was continued by the Kharkov group (of which Leontiev became leader; Woodward & Clark, 1996 and was populated by Vygotsky's students and co-workers who had "disserted" him; Van der Veer & Valsiner, 1991) during the 1930-1940's in which internal (mental) events mirrored and corresponded to external activities (Galperin & Talyzina, 1961; Kozulin,1986). Years later during the 1960's various aspects of the Kharkov group's work was considered as representative of Soviet development psychology including "perception as action" as pronounced by Zaporozhets as well as the concept of "step-by-step formation of intellectual actions" of Galperin (Kozulin, 1986). Galperin was a follower of Vygotsky's socio-cultural programme but developed its educational implications further and was involved in the foundation of the Kharkov school (Haenen, 2001; Wertsch, 2000). He deviated somewhat from Vygotsky on his emphasis on more reductionist approaches to the study of development criticising Vygotsky's all-encompassing and overarching sub-areas of concern (Van der Veer & Valsiner, 1991). He preferred to scale down as opposed to enlarging the subject domain. Passing away in 1988 he was one of the last people to have personally known Vygotsky although Vygotsky never joined the Kharkovites many of his students and followers did. Hence, emphasis within Russian dynamic assessment has traditionally been placed on two aspects; diagnosis of learning aptitude and Galperin's learning-teaching experiments (Lidz & Gindis, 2003).

"Destalinisation" or the depoliticising of psychological science resulted in the resuscitation of Vygotsky and the subsequent translations of his works into English and the criticism of Leontiev's work by Russian psychologists as well as the general restructuring of Soviet psychology (Bishop & Solso, 1996; Hydén, 1988). These 1960's translations culminated from the West's invigorated concern with cognitive aspects in psychology (after the so-called grand collapse or downfall of behaviourism; Green, 2001; Turner, 2001) which had under the behaviourist tradition been a non-issue (Valsiner,1988). It was also during the 1960-1970's that intelligence made its come-back in Russian psychology when tests were performed once again (Grigorenko & Kornilova, 1997). Vygotsky's work often reveals itself as thoughts and models in search of grounded theory, which he did not have time to formulate due to his untimely death. Translation of Vygotsky's work has undergone a parallel "Americanisation" which resulted in the loss of his poetic and philosophical style (Kozulin, 2002 in Ageyev, 2003) and has also been "tainted" by misunderstandings of his work primarily due to cultural differences between Soviet and American life (Ageyev, 2003). Ecosystemic models of human functioning closely align with non-Western dynamic assessment precursors (Valsiner, 1988) and as Robinson-Zanartu and Aganza (2000) point out, it is easy to understand why a systems thinking approach in dynamic assessment was only a relatively recent phenomenon in the West. It is interesting to note here that perhaps Vygotsky's unadulterated readings are more in keeping with South African collectivism as evidenced by the nature and culture of the reigning "Ubuntu" concept which essentially bespeaks of the greater good of the group versus the greater good of the individual (individualism as opposed to collectivism or American vs. Russian or European vs. African; Eskola & Weckroth, 1996 and where the psychology of person-in-society and the behaviour that accompanies it differs from that in many Western countries; Filatova, 1996). Over and above this rather simplistic rendering of another culture, is what Ageyev (2003) refers to as high- and low-context communication cultures which dictate the nature of communication. Westerners tend to be blunt and straightforward vs. high-context communication cultures which do not engage as directly. What is not said or done is equally as important as that which is said and done. This applies strongly to South African higher education circumstances. Perhaps this is why dynamic assessment has witnessed subsequent greater reception in countries presenting with non-individualised emphases. This is,

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[124] One gets the feeling that something similar was on the go during Nazi reign during which scientists relocated *en masse* to the West. The West has won over countless protégés due to totalitarian dictatorships and lucky for them that they did not languish in the gulags and concentration camps (Applebaum, 2003; Bishop & Solso, 1996; Freeze, 2000; Solzhenitskyn, 1974).
[125] Recall the now over-used example of Russia's isolationist policies resulting in among others the biological "science" of Lysenko! (McLeish, 1975).

however, changing as the world progresses to a more global and amorphous state. All cultures express in some form or another intelligent functioning even if it is not directly referred to as such and even within one single European framework competing alliances and histories evidence the varied paths followed by intelligence researchers. French research following after Binet, German research after Wundt, British work after Spearman and United States' following in the wake of, among others, Thurstone and Thorndike (Sternberg, 2004d).

Regarding learning disabilities, which in the West is attributed to internal functionings of the child, socio-cultural understandings emphasise external factors and stress that learning abilities are in fact learned. Neurological underpinnings are not, however, swept aside for one need only look towards the work of Luria on brain functioning and injury and who cited Vygotsky as his mentor. Socio-cultural and neurological theory become intertwined in the fuller understanding of the individual. Dialectical materialism as basis for much Soviet work is itself descriptive of research which poses contradictions in the hope of finding "true" information (Coles, 1982). The continuous interplay between polar opposites (or at least which seem to be opposed) brings about development. One can express it as the individual within society, the neurological within the larger system and learning abilities within socio-historical contexts. Such "activity" throughout life is not the equivalent of stimulus-response behaviour as understood by mainstream psychology as the mental intervenes and mediates responses. Pavlovian psychology was likewise criticised for this approach to human behaviour. Vygotsky transcended S-R research by including mediation yet also did not veer off into introspectionist psychology where consciousness studies often sought explanations by referring back to that which they were attempting to explain; i.e. a tautologous system (Kozulin, 1986; Leiman, 1992). Activity is a loose term and has undergone changes in definition since its inception in the 1920's (Kozulin, 1986).

The appreciation for the greater context in which humans live their lives formed part of Soviet understandings of life and regarded Western experiments within psychology laboratories with scepticism (Coles, 1982). Echoing the dialectical relationship between contrasting aspects, Vygotsky followed on in the tradition of seeking to integrate both learning and the development process, denying that the two worked in isolation. His thoughts and views on human development were not clearly defined into ready-made categories such as strict biological psychology, or wholly hermeneutic and cultural but have been described as being "in between" these various approaches (Brennan, 1982; Shotter, 1989). He also utilised static conceptions such as mental age and the validity of standardised assessment as reliable measures of psychological performance but did offer trenchant critique (Lidz & Gindis, 2003). This thesis advocates dynamic assessment as method of assessment but cannot ignore much good research that has emanated from static conceptions of intelligence and perhaps one should consider why Vygotsky would have tacitly endorsed these views. It is unlikely in science and psychological science that any one approach is so all-encompassing as to describe fully the behaviour of individuals. Likewise his conception of mediation is also not a unitary description and ranges from mediation of activity to the acquisition of scientific concepts (Leiman, 1992). In essence, Vygotsky's theoretical contributions towards a more fully integrated dynamic assessment in 2006[126] can be listed as follows (Lidz & Gindis):

- Psychological tools are in need of mastering by the developing child and this takes place within varied contexts such as language, cognitive and social development. Such tools are not individual implements but reflect social symbolism and communication (Kozulin & Presseisen, 1995). Tools can of course also refer to physical objects, which are made and utilised by human beings in a way not used by higher primates and other animals (Luria, 1994). The former relying on 'native physics' and the latter on visual cues with no use of symbols in anyway (Vygotsky & Luria, 1994). At least one can say that the same cognitive processes used are dissimilar, where primates may use spatial cues for manipulation of the environment, humans make use of causality
- Learning and instruction are intimately intertwined yet not identical (Kostyuk, 1972) and seeking the separation of the two will not result in a contextualised and situated approach as cultural-historical theory dictates (Menchinskaya, 1972). Vygotsky's emphasis on the interdependence of instruction on development is evident in his discussion concerning the appropriation of academic concepts through schooling (Vygotsky, 1994g). Hence the need to continuously inform assessment from mediation and vice versa (one of the main reasons why dynamic assessment is so burdensome within today's time-hungry and cash-strapped society). It is still the case in more instances than not, that dynamic assessment although attractive for a variety of reasons is still very difficult to implement in practice (Elliott, 2000)
- ZPD's size can change throughout life and is not fixed. This is in keeping with modern-day understandings of the plastic brain. ZPD can shrink and grow depending on the nature of intervention as well as on the timing of such intervention. The length of intervention or training will also likely change depending on the nature of the task and the level of experience. In keeping with cognitive theory which states that the more one knows the easier it becomes to know, ZPD and the handling of it becomes compatible with the broader encompassing cognitive theory
- The larger the number of currently maturing functions within the developing child the more indicative of potential as opposed to those functions which have already matured

[126] Although not as fully integrated as it perhaps should be.

- Shared or joint activity (with more able peers and teachers) stimulates the growing functioning of the child
- In order to ascertain or pinpoint maturing functions, collaboration is necessary
- Functions which are not yet matured cannot easily be used in assessment so the next best aspect to look towards is the level of imitation which indicates the readiness of the child to engage socially with his function (which is most likely the reason why Vygotsky emphasised the importance of play as measure and developer of cognitive functioning towards higher mental functioning but has been criticised due his overemphasis on imitation). Such higher mental functioning was assessed across domains including memory, attention and decision making (John-Steiner & Souberman, 1978; Kozulin, 1990)

Another giant in developmental psychology with whom Vygotsky is often compared and contrasted within the psychological development and educational literature is Piaget (DeVries, 2000; Duveen, 2000; Feldman & Fowler, 1997; Lloyd, 1995; Matusov & Hayes, 2000; Moll, 1989; Niaz, 2001; Santiago-Delefosse & Delefosse, 2002; Smith, Dockrell & Tomlinson, 2000; Tryphon & Vonèche, 1996). It can be postulated that Piaget approached the study of cognition from a structural position whereas Vygotsky did so from a functionalist point of view (Campbell, 1993; Moll, 1989). Piaget's work consists of many theories in contrast to Vygotsky's somewhat undeveloped scheme and much less experimentally validated theory (Smith, 1996). They are juxtaposed in terms of the respective theories' emphases on the individual within the social context and the social context as impinging on the individual as well as their respective views on accommodation and assimilation (Piaget) and ZPD (Vygotsky) (Van Geert, 2000). Vygotsky criticised certain aspects of Piagetian thinking (Santiago-Delefosse & Delefosse, 2002) yet read and commented on Piaget's work (Tryphon & Vonèche, 1996b). For instance, mediation does not feature as prominently in Piaget's works as they do in Vygotsky's (Haywood, 2003) even though it is appreciated that mediation of cognitive functioning does occur via a process within the developing child; the structural overlap between different stages require that certain functions become available (Case & Edelstein, 1993). As MartÍ (1996) states "the individual, endogenous, operatory, universal constructivism, which accounts for the progress of the Piagetian subject, is opposed to the social, exogenous, semiotic, and contextual development inherent in the Vygotskian subject" (p.57). The two did converge on the aspect of interaction in which mind collaborates with environment (Wozniak, 1996) and their overall aspiration of humankind towards rationality, although they placed emphasis on differing aspects (Piaget's end-point was a universal human rationality whereas Vygotsky proffered rationality in terms of its functional utility within the state and economy; Wertsch, 1996). The degree of overlap between the two is testament to the utility of a combined summation of their approach and the application of both frameworks in work with developing children (Bidell, 1988; Smith, 1996). Although Piaget was never to personally meet with Vygotsky, he did express admiration for his work and lamented about not having read his work earlier (Guthke & Wingenfeld, 1992). Piagetian tasks were employed in Russia during childhood assessments and the Soviet interest in Piaget can be explained by the need for the "new Russia" to conceive of a similarly "new man" and secondly Piaget's approach was one of the few options viable to the new Soviet psychology in terms of not being expressed nor couched within a bourgeois philosophy (Tryphon & Vonèche, 1996b). Evolution has been offered as an amalgamating framework within which to unify and view psychology; as the rationale is that all behaviour is a result of evolutionary adaptation and change. Piaget, did after all, enter the field from having studied biology to better understand the evolutionary practices at work within psychological descriptions of behaviour (Bjorklund, 1997; Li, 1996) and developmental psychology has obvious roots in evolutionary theory (Weinert, 1987). Viewing mathematical skill within both approaches evidences the differences between the two. Piaget emphasised the logical progression of understanding as the individual matures (innate preparedness) versus Vygotsky's emphasis on mathematics as a cultural tool which is mediated to children (Bryant, 2000; Resnick & Nelson-Le Gall, 2000). The dual roles and processes involved in development within the individual functioning within a broader context often results in the comparison of these two researchers' works. Yet a call for the synthesis of what can only be referred to as two great traditions (as many scholars have since made enormous strides within neo-Vygotskian and neo-Piagetian theory) makes more sense than a complete divorce and is encouraged generally but more so from an educational viewpoint where the learning process and development co-occur (thinking develops from teaching and teaching develops from thinking) (Shayer, 2000; Sylva, 2000).

2.7.2 Current trends

Awareness

Although more surveys may have been conducted, three surveys, conducted within the United States and United Kingdom evidence similar results in terms of the recognition of dynamic assessment as manner of assessment as well as the utilisation of this method within practice (Deutsch & Reynolds, 2000; Haney & Evans, 1999; Lidz, 1992a). Lidz's 1992a study surveyed 120 school psychologist trainers in the United States who co-ordinated graduate cognitive assessment courses. Due to the length of time that had passed since formal implementation of dynamic assessment models in the 1960's and 1970's Lidz (1992a) was of the opinion that information pertaining to these models should have seeped through to practitioners as well as academics in some form or another. Diagnoses form the mainstay of a school psychologist's agenda making this population a suitable target for answering questions concerning dynamic assessment. In essence Lidz's (1992a) survey encompassed questions concerning the familiarity with the model; the extent to which it is utilised; the manner of first becoming aware of the model; the extent of incorporation or reference to dynamic assessment within cognitive assessment courses; possible reasons as to why models

were not included in courses if knowledge did exist about the method; views concerning the assets of the model and lastly views concerning its major limitations. Results of this survey indicated that a clear majority of school psychology trainers were at least barely familiar with dynamic assessment. Of those citing "some" to "quite" familiar only 24% utilised the method. Hence there was till 1992 high awareness but little implementation. Most of those who stated their awareness of dynamic assessment became aware of it through reading.[127] Within the courses themselves and of those respondents stating at least minimum familiarity with dynamic assessment, 55% spoke about it in class, 32% assigned reading material but only 13% actually taught skills. [128] The main reason for lack of inclusion of course material within courses was due to the already full programme, followed by a lack of skills to teach the programme with fewer responses citing scepticism about the model. Also the most often cited assets of dynamic assessment were its process-based nature as opposed to mainstream emphasis on product. This was followed by the model's relatedness to intervention and its decreased bias in cross-cultural assessment. The obvious disadvantages cited were the model's demand on technical expertise which the respondents felt they were not equipped to handle along with the time taken for such administration and being able to utilise such assessment within a school setting. Time constraints as well as the fact that neophyte practitioners have to re-learn basic assessment paradigms (and in so doing critically re-appraise their mainstream training) has often been highlighted as problematic within the training of dynamic assessment practitioners (Losardo & Notari-Syverson, 2001; Meyers, 1987).

Haney and Evans' (1999) survey was a follow-up on the Lidz (1992a) study. They questioned the extent of dynamic and non-traditional assessment familiarity and utilisation, once again in the United States.[129] This survey consisted of 10 multiple choice questions and received a total of 228 responses (46% of the total), thus a larger sample was obtained in comparison to the Lidz (1992a) survey. Of the respondents who answered 93% had over 8 years experience in the field. For the sake of expediency only main results will be looked at here. Eighty-nine percent of the respondents indicated their involvement with children in one or other setting but only 42% indicated minimum to fair familiarity with dynamic assessment. Sixty-four percent indicated that they did not conduct dynamic assessments themselves citing lack of knowledge as the main reason followed by time constraints. The majority indicated that their use of dynamic assessment was limited to children with learning problems as well as those from minority backgrounds. Dynamic assessment was utilised as it enabled a greater understanding of pupils' strengths and weaknesses. In keeping with Lidz's (1992a) results most had come to know of dynamic assessment via reading the literature. The WISC-III as well as the Stanford-Binet IV was the test most often used for assessing minority children. It would seem that the Lidz (1992a) and Haney and Evans (1999) surveys concluded very much the same thing and that in a seven year period nothing much had changed. The results of a United Kingdom study will now be briefly looked at.

Deutsch and Reynolds (2000) conducted the first survey into dynamic assessment as available via training and the perceptions regarding the model within a sample of educational psychologists in the United Kingdom. The main difference in this survey was that the sample chosen to answer the questions had already been exposed to dynamic assessment training between 1994 and 1999. The main aim was to determine how effective the psychologists found the training to be; the extent to which they used dynamic assessment in their practices as well as the perceptions regarding advantages and disadvantages of the model within educational psychology. The questionnaire was piloted and consisted of eight multiple choice questions. As with the former two surveys only main results will be highlighted. A 74% response rate was recorded (out of a total of 119 questionnaires). Eight-five percent of the respondents were employed by a local education authority and over half had over 6 years experience in the field. Interestingly, it was the experienced psychologists who had the most interest in dynamic assessment (perhaps this is due to years of dissatisfaction within mainstream assessment). As with the two prior surveys, the majority of psychologists had come to know about the method through reading material or had heard about it from colleagues. Forty percent did not use dynamic assessment with over 52% only having used it for less than three years. Of those using dynamic assessment in practice, most spent less than 2 hours per week on the method. Time limits and difficulties of maintaining a dynamic assessment intervention programmes as well as lack of suitable support structures are mentioned as possible reasons as to the low level of utilisation. The linking back of information to the classroom as well as the cost of dynamic assessment materials were indicated as

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[127] Incidentally, the author came to know of dynamic assessment in 2001 after having contemplated the notion of how one could study a person's intellectual potential especially if current product-based scores were not very good indicators. After having searched for terms such as "potential" and "learning to learn" or "teaching thinking" (Narrol, 1996; Niaz, 2001) and so on in various databases it very soon became evident that a research area entitled "dynamic assessment" existed. Apart from a dedicated search into this area, all knowledge has since been obtained from reading the literature, so Lidz's (1992) results are quite understandable. More research results within dynamic assessment in South Africa is available (Murphy, 2002; Murphy & Maree, 2006) although it is now dated. The author has already started a preliminary enquiry into conducting a similar survey of awareness of dynamic assessment among psychologists in South Africa which, it is hoped, will be conducted in 2006-2007.

[128] The author did have the pleasure of delivering four lectures to third year undergraduate students in the psychology department at the University of Pretoria in 2003. Students were allowed a choice of questions to answer in the final year exam and the dynamic assessment module received the lowest number of answered questions! This could be due to a lack of familiarity with psychometrics or the lack of knowledge regarding the roots of dynamic assessment (Russian psychology and so on). Either way, it resulted in fewer papers to mark.

[129] Appendix 2 details the content analysis of a questionnaire sent out to over 100 dynamic assessment researchers and/or practitioners across the globe in 2005. Due to the paucity of the results, as mentioned, the results are included as an appendix only. After having the studied previous surveys, the author understands more so than before that the questions were alarmingly detailed thus perhaps contributing to the small number of responses.

negatives. Thirty-four percent indicated that their dynamic assessment training was only partly adequate in obtaining their professional goals citing insufficient basic training as main reason for not meeting their training requirements. Dynamic assessment advantages include its flexibility, its positive experience-creating manner of assessment, its interactive nature, its practical advice-bearing manner offering an alternative to mainstream psychometrics, its culture-fairness and its rich source of information. These were cited as the perceived advantages of the method. Deutsch and Reynolds (2000) contend that the best known researcher within dynamic assessment in the United Kingdom is Feuerstein, who, they state, has not encouraged utilisation of his model outside Israel. In sum, there is a need to circulate more information about dynamic assessment within the United Kingdom.

Greenberg (2000) reflects on the four aspects necessitated by those thinking of adopting a dynamic assessment approach in practice and in keeping with the above-mentioned factors in terms of dynamic assessment's disadvantages, the following is highlighted:

- Various models and theories need to be understood before the embarkation into dynamic assessment
- The devices available need to be understood in terms of their workings
- Dynamic assessment is inherently a loose set of tailored approaches and depending on the context and person being assessed needs to reflect this individuality of assessment
- The need to link up dynamic assessment with classroom intervention poses a particular problem as there is usually a lack of human and financial resources

This is complemented by the following comments from Kaniel (2000) who states that according to his definition of dynamic assessment the following is endorsed:

- Dynamic assessment should include as an inherent feature of its approach assessment and intervention
- What makes the situation dynamic, is the dynamic adaptability of the assessment to the person
- The tasks involved in assessments should reflect the interests of the client and should take place in a relaxed atmosphere
- People themselves are dynamic beings and both process and product should be assessed
- Due to its malleable approach towards assessment, dynamic assessment presents with an eclectic array of techniques in its repertoire and hence should not and usually is not bound by certain strategies (as has been previously mentioned this is perhaps one of the characteristics with which some mainstream assessors have a problem)

In addition to this, the usefulness of professional societies and governing bodies as well as informal groupings may well aid in the further awareness, acceptance and influence of dynamic assessment. Now that a sketch has been illustrated regarding the beginnings of dynamic assessment an equally brief account will be given as to its place within the larger realm of intelligence with which it is most commonly yet not exclusively associated.

2.8 Intelligence

This term is either accurate in its varied semantic interpretations or it falls woefully short of any apt description to date. Some view it with awe and others with suspicion; frequent attempts are made to deny its importance and no less are attempts made to leverage its status as scientific. It appears at once as scientific and pseudoscientific, a misnomer waiting for reclassification into a system more worthy of study or an area already substantially endowed with copious literature attesting to its stature as recognised domain of necessary interest and research. Dynamic assessment needs to be placed within a domain and it is usually the domain of intelligence in which it is fatefully lodged, much to the dismay of some and elation of others. There is much to do with intelligence about which we are uncertain but there is something which none can deny: intelligence's history. Whether it be vilified or regaled, it is nevertheless rich in its historical deposits of research findings and ongoing debates. The innate need (it seems) to classify, judge, compartmentalise and determine a sense of hierarchy can perhaps be said to issue forth from our evolutionary heritage as mammals where the establishment of some sort of controlling system was necessitated in order to live in a more harmonious fashion than that which is frequently reflected in nature. The study of intelligence is a continuous activity carried out by most people everyday in life, our jobs as researchers is merely to systematise this knowledge and information into one system known as science.[130] With this rather unscientific introduction, a brief detour into the realm of intelligence is now taken.

[130] A relativist stance once again is proffered as acknowledgment towards other systems of knowledge, but as is now known, the author views "science" as the more relevant system and does so without qualms.

2.8.1 Desperately seeking a definition[131]

There is no definitive definition of intelligence and no-one knows what it is (Neisworth & Bagnato, 1992; Newell, 1990; Sternberg, 1997c; Undheim, 1987). Moreover it is a tiresome exercise to try and define it (Jensen, 1982b) as there are seemingly unlimited manifestations (psychometrically and neurologically) of what it supposedly is (Fuster, 2005) and also how it is methodologically represented (Henry, Sternberg & Grigorenko, 2005). It is at once a workhorse and a diva because "the construct is extremely useful, but we do not have a proper definition of what it is and what it is not" (Wilhelm & Engle, 2005, p.7). The word "intelligence" was first utilised in Spencer's 1855 evolutionary-oriented text on psychological principles which is particularly significant given the author's own definition of intelligence below (Jensen, 1998b). To understand that the concept was couched in evolutionary terms upon initial use and to witness the definition come full circle some one hundred and fifty years later is indeed simultaneously surprising and unsurprising depending on one's point of view and frame of reference. Two major theorists within the field have this to say about intelligence and it is necessary to quote verbatim just for decisive and emphatic clarity:

- Butterfield, Siladi & Belmont (1980) – **intelligence develops** (p.96)
- Anderson (1994) – **intelligence does not develop** (p.1)

There are multitudinous views in between the above-mentioned. There is no agreed upon definition of intelligence, primarily because there is no agreed upon construct and secondly, when a construct is defined, it is presumed measurable (see chapter 4) when it is not necessarily the case. So within this contrived situation psychologists are left wanting a construct, a definition and a manner of research.

Dynamic assessment is leveraged upon this.

There are many definitions. Seeing as the literature concurs with both these statements, it is decided upon to use the author's own definition, seeing as it as good as any other! Intelligence, simply put, *is the evolved ability*[132] *to survive on our planet and this includes the degree to which we can adapt to changing circumstances.*[133] There is no teleological side to this statement, it is not that intelligence evolved to some point to assist in adaptation, but due to selective adaptation and successive fit within environmental press, genetic combinations that have survived in their current form are those that were selected "for" in evolutionary terms (Terman, 1921). We are not verbally acute so as to pass SAT's; we are verbally acute because the genetic-environmental press had it such that this combination was able to successfully exist within successive generations and it just so happens that SAT's are able to pick up such intellectual adaptation. In fact this definition comes very close to a definition of learning potential as cited by Van der Aalsvoort and Lidz (2002) who state that learning potential overcomes what a definition of intelligence seems to have evaded, namely, how environmental demands influence the adaptive capability of the individual and concurs with Hamers, Hessels and Pennings' (1996) definition of learning potential as the capacity to adapt to new situations by drawing on past experiences. Sternberg (1996b) also draws attention to the difference between intelligence as measured by conventional IQ tests which do fairly represent future academic achievement and later success in life (even though it has been

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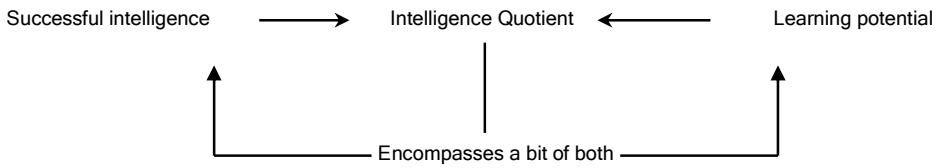
[131] Bereiter's definition is perhaps the catchiest one, stating that "intelligence [is] what you use when you don't know what to do" (in Jensen, 1998b, p.111). Now, the effort comes in where one needs to capture the process of doing something when one does not know how.

[132] In agreement with Jensen's (1982b) determination of intelligence as a product of biological evolution. But this is obvious – what else could it possibly be?

[133] This includes the ability to adapt to a new job, a new country, a new planet; in short anything that will ensure our survival beyond that which attests to our physical survival (Sattler, 2001 in Gregory, 2004). This definition also allows for coverage of animal intelligence, both vertebrate and invertebrate (Menzel & Bicker, 1987) and can be linked to isomorphic renderings of theoretical constructs as already commented on in this study and as Schafer (1982, p.183) said over twenty four years ago; "the electrophysiologically *adaptable* brain should be the behaviourally bright brain" (own emphasis). Intelligence is most likely a by-product or exaptation of our evolutionary change (Kanazawa, 2004), a spandrel in the words of Stephen Jay Gould. Should environmental press favour less intelligent beings then our levels of intelligence many generations hence will most likely be less intelligent. There is no end point of greater intelligence, there is no teleological argument here. Put simply, evolution is change; it is human beings who decided on whether to construe such change as "good" or "bad". There are no moral codes, no ethical standards; just reality as it has been for millions and millions of years. Is this a relativist take on the process of adaptation? Perhaps some might see it so, which is contrary to the views espoused in this chapter thus far. Yet, it is this stark reality with which many find difficulty in comprehending, especially in the social sciences. Note that the term "ability" lacks clarity and is itself suffused with loose conceptual constructs, for, is an ability linked to general intelligence (at least within the psychometric paradigm)? Or can an ability exist without recourse to correlational links to general intelligence (as evidenced within multiple intelligences?) (Howe, 1996). The definition given above treats the concept "ability" as a layman's interpretation or an intuitive practical definition. Adaptability is core in this definition because it results primarily due to learning, both at global behavioural and neuronal levels (Posner & DiGirolamo, 2000). Learning is key to dynamic assessment; thus linking the commonality is not that difficult to envisage. The idea of adaptability can also be partially linked to Wechsler's original definition of intelligence "… to deal effectively with his environment" (Ryan & Lopez, 2001) as well as to Stern's notion of intelligence being defined by the manner in which novelty is dealt with (Pascual-Leone & Johnson, 2005). Broad-based adaptability also encompasses what the PPIK theory of intelligence asserts is intelligence; namely, intelligence as process, personality, interests and intelligence as knowledge (Ackerman & Beier, 2005). This is appealing but the swift pull of the spiralling vortex can already be felt as one is sucked into yet another "nice" theory which is simply too broad to be rendered useful.

posited that IQ tests are founded on naïve theory of intellectual functioning; Brown, Campione, Webber & McGilly, 1993)[134] and successful intelligence which he regards as the ability to profit from past experience. Adaptability is key in Sternberg's (1997b) understanding of intelligence and successful functioning and intelligence as the ability to learn (Ones, Viswesvaran & Dilchert, 2005) is hardly much different from the defining criteria for dynamic assessment which is simply more process orientated in this regard. In this vein then, successful intelligence as a theoretical construct comes closer to learning potential as theoretical construct. One could perhaps envisage a continuum with IQ bridging far left and far right constructs such as depicted in figure 10 below and is similar in nature to figure 11 which contrasts lay-conceptualisations of intelligence with those of expert opinions. The author does however disagree with the sentiments conveyed by Greenspan and Driscoll (1997) who state that adaptive functioning is sometimes utilised to counterbalance IQ referring to aspects of personal competence other than what is traditionally understood to be IQ. It is emphasised therefore, that adaptive functioning[135] too has manifest variance; some are better able to adapt than others in certain situations (also by creating and shaping their own environments; Sternberg, 1997c) and so on and this is evidenced in developed countries where adaptive increases in cognitive ability is promoted by environmental factors which are not as prevalent in developing countries (Barber, 2005). Adaptive functioning in our evolved past had resulted in a plastic brain which, some say, caters for an environment quite dissimilar from the one we currently inhabit (Strauss, 2005) although the counter argument here is that the very uniqueness of human brain plasticity makes our adaptations so much the better. Trainability, which is a key point within dynamic assessment concerns, is yet another link that can be fostered in bridging the gap towards intelligence as is evidenced in the literature, those with higher IQ's are more receptive to training and are hence more "trainable" (Lyyn & Vanhanen, 2002). This is clearly seen in much of South African dynamic assessment research. *G* has also been proposed to have evolved as domain-specific adaptation to a narrow sphere of "evolutionary novelty" which has since proven its worth due to the novel-rich world in which humans currently find themselves resulting in *g*'s now "general" status (Kanazawa, 2004). This ties in with the above statement regarding developed countries which indeed have more novelty impinging on their brains. Kanazawa's (2004) theory does however fly in the face of the generally accepted understanding of *g* as general underlying mechanism as it proposes *g* as merely one module in the evolved brain's repertoire of modularised functioning and does not build on empirical support[136] (Borsboom & Dolan, 2006). Perhaps it ties in with Sternberg's triarchic theory in some manner as this theory has not evidenced a general factor pervading the sub-tests of the ability tasks but rather specific abilities (Sternberg, Ferrari, Clinkenbeard & Grigorenko, 1996) so perhaps it is worth looking towards modularised *g*. The latter authors cogently argue for *g*'s hypothetical nature as source of individual difference and not as a reified mechanism of mind. This notion is reiterated throughout this study.[137] Hambrick's (2005) evidence illustrates that *g* does not necessarily account for expertise in task performance or on-the-job performance as much as domain knowledge for instance which accounts for greater variance explained as predictor of performance. The accumulation of knowledge in general but in particular task-specific knowledge thus plays a large role in determining success at the task. However, the retort to this (in support of *g*) could be that *g* underlies this very ability to accrue information more efficiently. It seems that everywhere one goes, *g* is sure to follow.

Figure 10 A possible alignment of IQ within the continuum of successful adaptation as differentially measured



Adaptability could mean many things to many researchers and in keeping with Hansen's (2003) link between intelligence and learning ability a case could be made for linking the above broad definition of dynamic assessment, "[they] become better learners in other words, they become more intelligent" (p.60). Donald (1997) views adaptability at the neuronal level noting how neural plasticity has allowed for human cultural development of language and writing which, he states, is not a module housed within the brain but reflective of the brain's changeability to its environs. Moreover he argues that cognitive "fundamentals" are

[134] For instance, certain sub-tests utilised within intelligence tests such as inductive and deductive reasoning tasks are in fact not unified in terms of the underlying construct they purportedly measure (Wilhelm, 2005). This thesis does not look into the matter of the nature of the tasks utilised in test batteries and upon visiting some of the literature concerned seems to be yet another contentious area of debate within the field.
[135] As Greenfield (1998) states, everyone has the ability to adapt and she refers to this as "panhuman genotypic intelligence" (p.81), but it is not this which intelligence tests measure.
[136] One could alternatively also argue that the factor analytic tradition was too heavily data-driven and theoretically weak (Taylor, 1994). So which do we need? Or at least, what criteria should be used to determine the veracity of a theory; its data or its theoretical grounding? This discussion will be taken up in chapter 3 when the method of science is discussed in greater detail.
[137] Will there ever be a resolution? Perhaps we are once again asking the wrong questions or at least asking them in the wrong way. Can natural science methodology aid us in this endeavour at arriving at some sort of resolution? Here, a plea is made for psychology to deviate and follow natural science methods of explaining away occurrences. It is anyone's guess as to how successful such an endeavour will prove to be.

not necessarily biologically universal but unique to specific cultures. Berry's (1998) opinion on intelligence also pivots the notion of adaptability but in this instance it is the adaptability to culture which is essential in determining group survival. Different cultures vary on their responses to different test items, thus "phenotypic intelligence varies from culture to culture" (Greenfield, 1998, p.81). It also veers closely to the definition of Feuerstein's modifiability of the individual (Schur, Skuy, Zietsman & Fridjhon, 2002) and buffers the notion of cultural adaptation and deprivation as paramount to intelligence functioning as opposed to a strict and narrow construal of intelligence per se as utilised within Euroamerican psychology (Berry, 1998; Gardner, 1998) or as perceived by society in general (Carroll. 1998). Via the meaning of adaptability, learning as a process-oriented concept also veers away from constraining itself in reified terms as the static definition of intelligence is often viewed (Feuerstein & Kozulin, 1995). Assessment of adaptive functioning within various contexts other than those assessed within schooling contexts reveal holistic pictures of general functioning which can easily shed light on functioning within specified narrow contexts (Oakland, 1980). There are many research traditions within the intelligence field emanating from across the world with numerous "mini" traditions in each. There are remarkable similarities between some traditions evidencing coalescence of thoughts and thus indicating that there are indeed universal concepts and criteria of "intelligence" (Sternberg, 2004b). Although layperson definitions of intelligence also form part of many cultural systems and appear very different in nature to one another (Baral & Das, 2004, Mpofu, 2004) far more testing carries on unabated informally than does so within controlled testing environs (Weinberg, 1989).

Natural intelligence and artifactual intelligence as described by Glaser (1998) in a manner resembles Vygotsky's lower and higher order thinking where performance within a given cultural setting is normal but skills need to be taught for higher order processes as required by schooling. It is the latter which is problematic within culturally diverse and deprived individuals and usually not the former. Of course this implies that the latter test for only school-like subjects, which it does, more often than not. Hence, are the correct questions being asked? Colvin (1921) stated many years ago that he was, in principle, in agreement with the above-mentioned definition but considered it too broad as it encompasses instinctive as well as learned behavioural adaptation to the environment. This is true but evolutionary adaptation to the environment is no less an indicator of intelligence than anything else yet once again criticisms are lodged at this broad notion of defined intelligence (Cowan, 2005). Intelligence research is perhaps problematic for the reason that we might very well be asking the wrong questions[138] (Estes, 1998) and it must be noted that definitions are only as good as their utility in explaining away aspects pertinent to the intelligence debate (Zigler, 1998). Utility value is perhaps the most obvious in naturalistic or everyday settings where intelligence is valued according to a number of "lay" criteria, that when studied closely, reveals its similarity to expert definitions of intelligence (Kail & Pellegrino, 1985). Yet, Derr (1989) and Sternberg (1979) warn against the admixture of both lay and informed views of intelligence definitions as this matter is one for science and not for ordinary discourse. Derr (1989) also posits that some conceptual confusion could well dissipate if such considerations were given their due. Unfortunately, common understandings of intelligence have not yet filtered through to informed conceptualisations as previously envisaged (Turnbull, 1979). Figure 11 illustrates the extent of considerable overlap between lay and expert opinions on intelligence and overlays a few concerns and areas of connectivity to our evolved selves. Figure 12 which follows illustrates Greenspan and Driscoll's (1997) content model of personal competence which itself draws on Sternberg's research into lay and expert opinions regarding intelligence. Note the overlap between social competence, intellectual competence within the "everyday" sphere and the academic sphere. As is evident, this represents a continuum approach towards the understanding of intelligence and what it means to function intelligently in life in general. Overlaid are aspects of importance to dynamic assessment's understanding of how intelligence functions. The authors attempt to capture within one model the overlapping areas concerning intelligence and personality; an area already addressed within some dynamic assessment initiatives.

[138] Could it be that the situation will resolve in a manner surprisingly simple yet effective? Perhaps our questions are not so much incorrect as too complex? Possibly not but it is something over which to ponder.

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Figuree 11 Lay and expert opinions about intelligence (Gregory, 2004, p.142; Sternberg, 2004c, 2004e). Concerns about interpretations

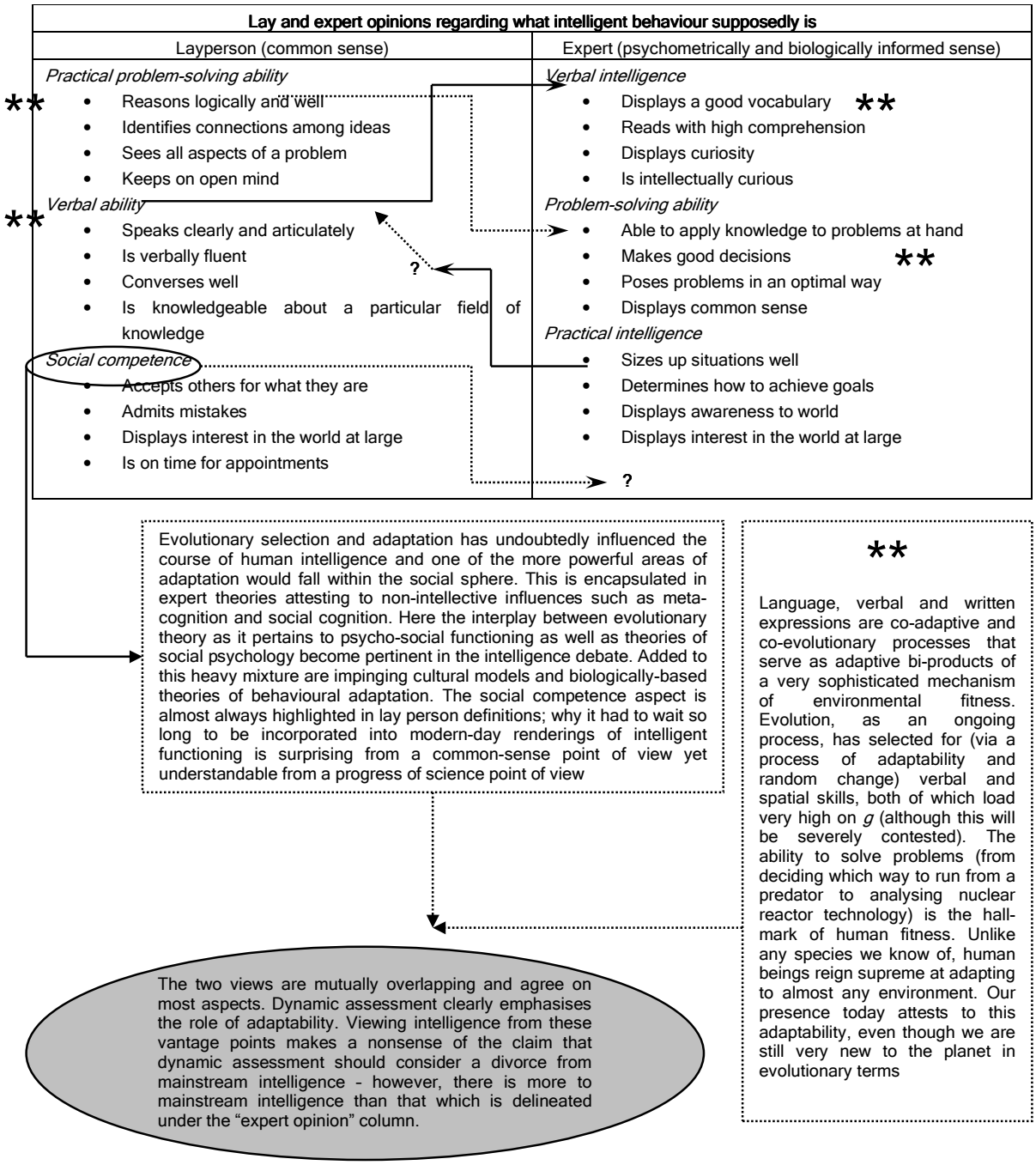

Figure 12 Greenspan and Driscoll's (1197, p.133) content model of personal competence with attending aspects of importance to dynamic assessment

If we look at figures 11 and 12 it is immediately evident that one aspect stands out: that of practical or social intelligence which plays a large role within evolutionary theories of intelligence and survival (ability or proclivity to detect cheaters and so on cf. Cosmides and Tooby in general). It is also the construct within intelligence research which most appeals to intuitive ideas of intelligent functioning (Matthews, Zeidner & Roberts, 2005). Kanazawa (2004) firmly states the case for *g* as evolved modular ability and posits the following regarding *g*:

1. Intelligent (high-*g*) individuals are better able to solve problems than less intelligence (low-*g*) individuals, *only if* the problems are evolutionarily novel
2. Intelligent (high-*g*) individuals are no more able to solve problems than less intelligence (low-*g*) individuals, *if* the problems existed in the EEA [environment of evolutionary adaptedness] and are thus evolutionarily familiar

Hence, the case for adaptability and "everyday" or social intelligence has merit which can be tapped by dynamic assessment theories and models more so than current mainstream assessment which concentrates on only a specific sub-set of intelligence-eliciting tasks. However, and this is a big however, it is these very sub-sets of tasks which are manifestly evident and obviously so in the world we now inhabit. If you want to be successful, one does need high *g*-loading abilities for specificities and this does not seem as if it will change any time soon.

2.8.2 Approaches towards the study of intelligence

Utility and parsimony (see chapter 3) are hallmarks of good theories and intelligence theorising is an area of investigation which needs severe delimiting or theoretical excision in order to prove successful (Snow, 1998b). All theoretical programmes (for instance information processing, learning, factor-analytic and cognitive developmental) are by their natures limited to and by their areas of investigation and points of departure (Li, 1996).[139] Intelligence theories explain different things about the same phenomenon, with some theories tending to seek structure, others seeking causes of such structure whilst others emphasise function and thus results in different conclusions (Carroll, 1994).[140] In accordance with the above definition, is the embedded notion of intelligence as problem-solving ability as one necessarily has to solve various problems in the game of adaptation (Wenke, Frensch & Funke, 2005). Along with the assessments of problem-solving myriad other aspects tie in with intelligence assessment, such a cognitive speed, perception, attention and memory, hence the diverse array of intelligence sub-componential research areas. Is it perhaps possible to study intelligence without the use of the concept itself (Grigorenko, 2004b) seeing as it poses such problems? The concept "intellect" (reason) and "intelligence" have followed different historical paths and can be separated within the mainstream intelligence arena, at least within the predominant traditions. Russian concepts of intelligence have fused the two rendering a definition of intelligence without recourse to the necessary definition so espoused within Western traditions. Soviet psychological history and Vygotsky's movements within have already received brief attention above, so it is not surprising to find that intelligence research as well has received varied interpretations (Grigorenko, 2004b).

Factor analytic explanations of intellectual structure can inform and be informed by other manners of viewing intellect, so no one view can be said to represent all there is to intelligence. Behavioural genetics can at least attempt a partial explanation of how and why factor analytic structures form in the manner they do (via intelligence assessment and general modelling of cognitive growth; Cherny, Fulker & Hewitt, 1997); the father of whom is Galton (Jensen, 1997) who also introduced twin and adoption method studies (Bouchard, 1997). Given the time and context during much of early intelligence research historical development, is it really surprising that statistical envisioning of intelligence predominated? (See chapter 3 for more on the context prevailing at the time). Psychometrics aims to measure and quantify whereas more biologically attuned models of intelligence seek to provide explanation about developmental change while behavioural genetics attempts to account for heritability changes throughout life and how this impacts on or is impacted by *g* (Ceci & Bruck, 1994). See figure 15 for a depiction of these views. The plea for subsequent melding of approaches can only but benefit the discipline although Sternberg's (1997) warning cannot be ignored where it is stated that the biological approach towards intelligence has yet to offer lucid approaches towards the integration of biological models of learning and how learning occurs within practical settings but the statement from Brody (1992) also cannot be disregarded, that intelligence is a heritable trait. Note here, however, that dynamic assessment translates "trait" into "state" and hence moves away from the immutability concept to one of modifiability (Feuerstein & Feuerstein, 2001). This implies that there are biological correlates of intelligence with findings from inspection time studies to event-related potential studies informing different aspects of information processing (Fernández-Ballesteros & Colom, 2005; Li & Kunzmann, 2004). "It is relatively easy to discover the biological correlates of intelligence but it is relatively difficult to determine the *causal* relationship between a biological measure and intelligence" (own emphasis) (Brody, 1992, p.215). Researchers still remain within a theoretical vacuum regarding intelligence theories even though technological advances have forged ahead (Eysenck, 1994). Looking more closely at the delineation of these four paradigms of intelligence explanation (considered the prevalent ones but by no means the only paradigms), it can be seen that dynamic assessment philosophy is more firmly entrenched within the learning and cognitive developmental paradigms. Figure 13 depicts these views. Figure 14 illustrates the realms of theory and substantive realities and the placement of intelligence and dynamic assessment within them. Note the schism between the two realms. This notion is continuously echoed throughout this study. As Sternberg (1994c) succinctly notes, if conventional intelligence tests only predict between five and ten percent of various life measures of adjustment and success where has the other ninety to ninety-five percent disappeared to? Clearly this hypothetical construct cannot adequately account for reality as it is experienced.

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[139] The same type of delineation of research angles can be seen within neuroscience endeavours where brain functioning can be mapped according to sequential anatomical, functional or organisational frames of reference (Chugani, Phelps & Mazziotta, 1994).

[140] The number of frameworks used to study intelligence in fact almost mirrors the number of definitions available! Another simplistic manner of investigating intelligence would be to divide theories and models into what Weinberg (1989) refers to as "lumpers" and "splitters" referring in turn to *g*-based and multiple intelligence based approaches. Perhaps the manner in which we choose to study intelligence is itself reflective of initial tacit assumptions.

Figure 13 Paradigms within intelligence explanation (Li, 1996) with problems overlaid

Some current prevalent influential paradigms and their attendant problems *(with Sternberg's 1997 divisions in brackets)*
Information processing paradigm (psychometric) o Sternberg's triarchic theory – broader and more encompassing than its predecessors in its inclusion of social and contextual factors. The notion of learning is not, however, considered an independent construct
Learning paradigm (anthropological and computational) o Butterfield's components of intelligent action – in which learning and the information processing paradigm are both accorded framework status. For instance, once a knowledge base becomes exhausted in terms of aiding in skill acquisition, learning is said to occur, where new executive routines are learned o Brown and Campione's learning potential – change construct is problematic because its foundationary construct is itself problematic. Dynamic assessment fits in here as well as below under cognitive-developmental models o Snow's six aspects of intelligence – learning is adaptive and changes according to the requirements of the context. Learning differs not only between but within people depending on the context o Schank's artificial intelligence – recursive argument[141] inherent yet can be extremely useful. By considering learning, understanding and explanation without the attendant non-intellective aspects via a process of information gathering, learning very much hinges around adaptive functioning calling on past experiences in informing present decision-making o Perkins's learnable intelligence – if intelligence is learnable then we all learn in differing ways, which brings us back to the original concern of individual difference research, so one might just as well change the research label from intelligence to learnability. Has some common concerns with dynamic assessment
Factor analytic (psychometric and biological) o Jensen's *g* – as has been stated repeatedly, the author's preferred realm of discussing intelligence but still too narrowly defined to be useful in the practical world (at this point in time, perhaps the future will be more conducive as technology improves) o Also known as the laboratory-based approach towards intelligence (Gardner, Kornhaber & Wake, 1996) o Eysenck's biological basis of intelligence – in keeping with the above, the author seeks to forge cross-disciplinary expertise for intelligence, dynamic assessment and biological basis of behaviour and intelligence. Yet this too is not practicable at present o Horn's psychometric construal of intelligence theories as being a mixture of various approaches towards understanding intelligence – who has tried to make a case for both multiple and unitary forms of intelligence. Which has resulted in our asking whether those ill-posed dichotomies are really useful within the social sciences? See chapter 3 for more o Ackerman's Radex model – visually similar to Feuerstein's cylinder model yet different in its conceptualisation
Cognitive developmental (epistemological and systems) o Piaget's cognitive-stage theory – a group of theories now known to be inaccurate and contested (in detail not necessarily as a whole) yet powerful in its descriptive novelty - dynamic assessment fits in here as well as above under learning models o Glaser's cognitive efficiency theory – conceives of natural and artifactual intelligence with the former being inherently learned and the latter being taught. Similar overtones can be seen in the theories of dynamic assessment models. How one performs is dependent on what one has learned but does this answer the question of the nature of intelligence? o Zigler's social competence – the non-intellective is stressed in this research model such as motivation. Increasing awareness of non-cognitive aspects is a current trend within intelligence research and has formed part of the dynamic assessment paradigm since its origins o Gardner's multiple intelligences – a modularised approach in determining the nature of intelligence which ironically by its very arguments for modules has highlighted the role of governing *g*

[141] Very similar to Dennett's views concerning qualia and studies relating to this topic. "It's not hard to see how philosophers have tied themselves into such knots over qualia. They started where anyone with any sense would start: with their strongest and clearest intuitions about their own minds. Those intuitions, alas, *form a mutually self-supporting closed circle of doctrines*, imprisoning their imaginations in the Cartesian Theatre" (own emphasis) (1993, pp.369-370). The inherently recursive or closed circle is perhaps the biggest draw-back when one views the workings of the brain from a computer-based perspective.

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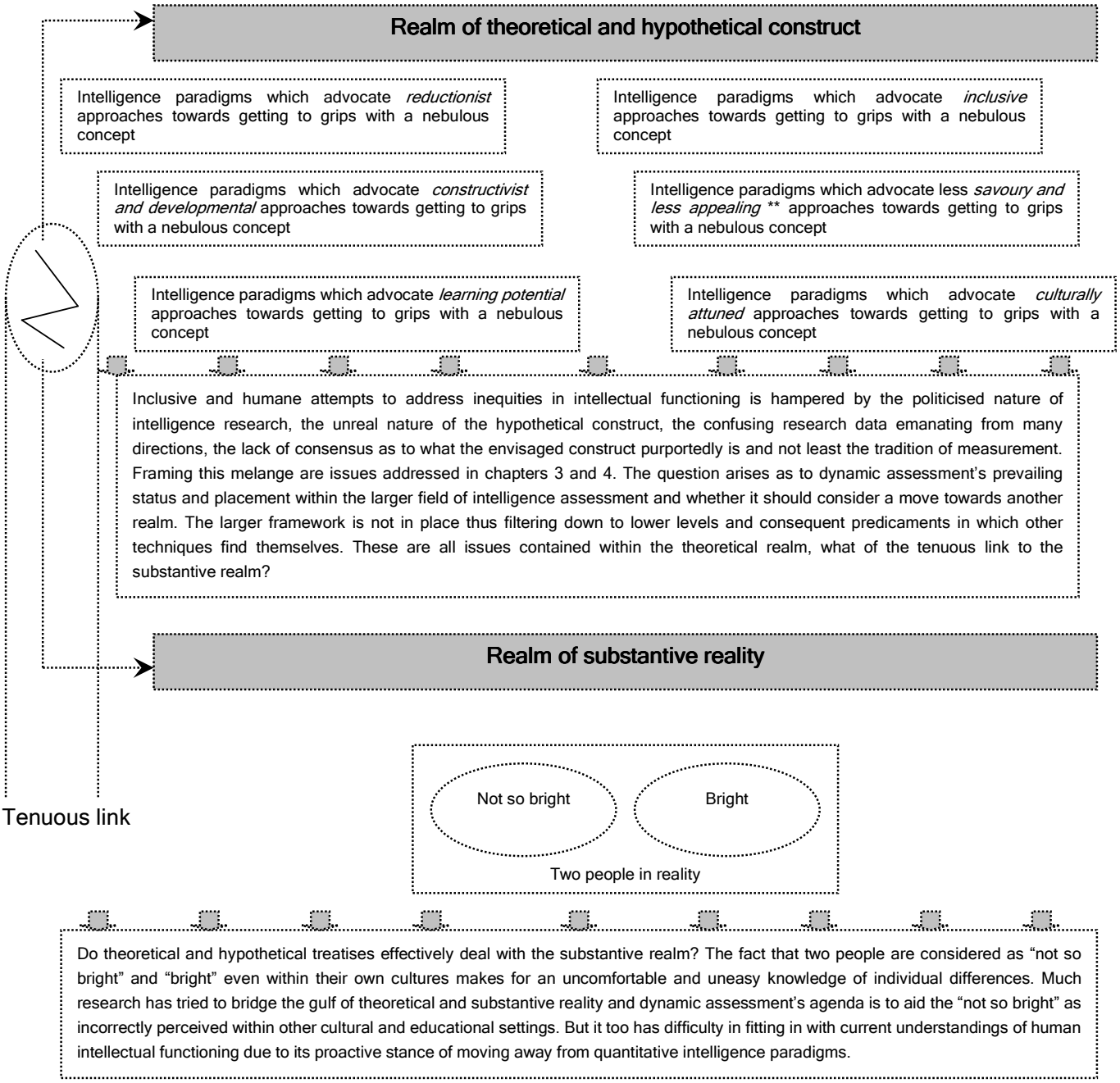
Figure 14 Intelligence within two realms



** however unpalatable and currently socially unacceptable it is to mention social inequities, one simply cannot turn a blind eye to stark reality which has, in the past, does so currently and will most likely do so for many generations to come, illustrate that not all are allotted equal propensities and opportunities in life in general. This does not in anyway entail a need for a eugenic type resurgence of any kind but it does behove the researcher to acknowledge that such differences are manifestly obvious but need to be tactfully approached (Loehlin, 1992). Simply because some compensatory education programmes may not have yielded great gains in the past (Jensen, 1969) does not mean that mediatory steps should not be taken to try address low performers; as large scale compensatory programmes cannot necessarily be equated with dynamic assessment for instance. One need only look at the recent literature (Hunt & Sternberg, 2006; Jensen, 2006; Sternberg, Grigorenko & Kidd, 2005; Templer & Arikawa, 2006) to view the still-current and heated debates surrounding intelligence and race. In keeping with tenets developed in chapter 3, the author fully upholds the sentiment advocated by Detterman (2006) in his editorial review policy for "Intelligence" which is worth citing word for word, "I believe that it is important that controversial ideas have access to the pages of this journal. Without a forum for the resolution of controversy, controversy will not be resolved and science will not advance. If a journal does not advance science, then what good is it? All it can do is fortify the status quo" (p.iv).

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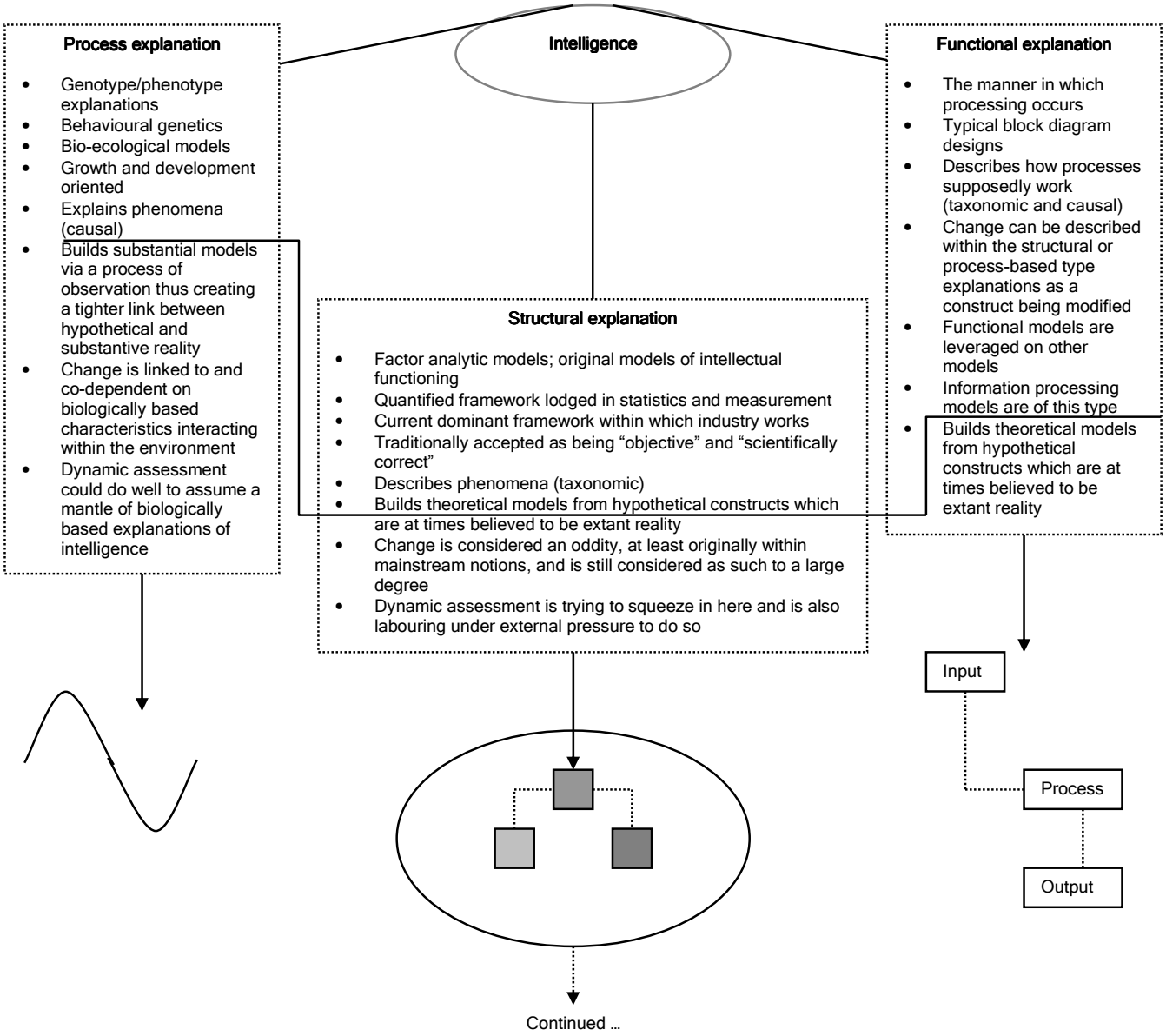
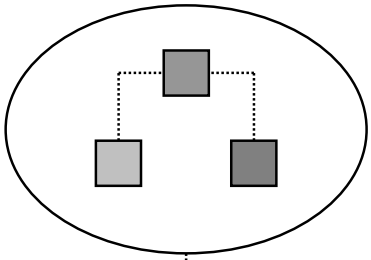
Figure 15 Different approaches towards the study of a single issue

Do not know what "intelligence" is but can surmise from what we do already know. It is a construct-fuzzy notion

It is one thing and many things. It is *g* in turn made up from many *s*'s. It is not a unitary concept but somehow we always find it lurking in the data





Elaborating on the structural explanation

The structure of intelligence and its key historical representatives (Brody, 1992, 2004, Davidson & Downing, 2004)

- Cattell's theory of fluid and crystallised intelligence which resembled Hebb's theory of intelligence A (biological) and B (cultural). Fluid is largely genetically determined and decreases with age whereas crystallised increases with age in tandem with experience. Cattell's theory grew from the factor analytic work of Thurstone and his primary mental abilities and consisted of second order factors as well. Horn modified Cattell's theory in more recent years and utilised cognitive measures to derive the second-order factors as opposed to Thurstone's factor analytic analyses of primary mental abilities - note here the difference between theoretical and substantive measures! These initiatives sought to move away from Spearman's global dominant notion of *g*. Humphrey re-analysed Cattell's data and showed that the two factors could be subsumed within a global factor and was in keeping with Vernon's hierarchical notion of intelligence (note the swing of the pendulum)
- Guttman modified factor analysis and developed the Radex theory in which complexity and content differed for various tests which could be displayed and conceptualised as a simplex and circumplex model and is visually appealing
- Guilford's theory illustrated his idea of intelligence (non-*g*-based) as being made up of three dimensions; operations, contents and products. Along these dimensions operated five areas, cognition, memory, divergent production, convergent production and evaluation which could be applied to four content areas; figural, symbolic, semantic and behavioural (the author often thinks of Feuerstein's model when viewing Guilford's model). Guilford's model has been criticised for being too cumbersome and complex especially given the data he utilised which was seemingly unsupportive of his own theory
- Gardner's theory of multiple intelligence can be slotted into the structural category although it can and has been accommodated under cognitive developmental (epistemological and systems) categories (see figure 13 above). This categorisation depends, of course, on the literature. Gardner has garnered support for his view on intelligence from various areas such as brain damaged patients, non-average performing individuals such as savants, expert performance analyses, experimental psychological tasks and from psychometric findings

2.8.3 Situating aspects of intelligence measurement

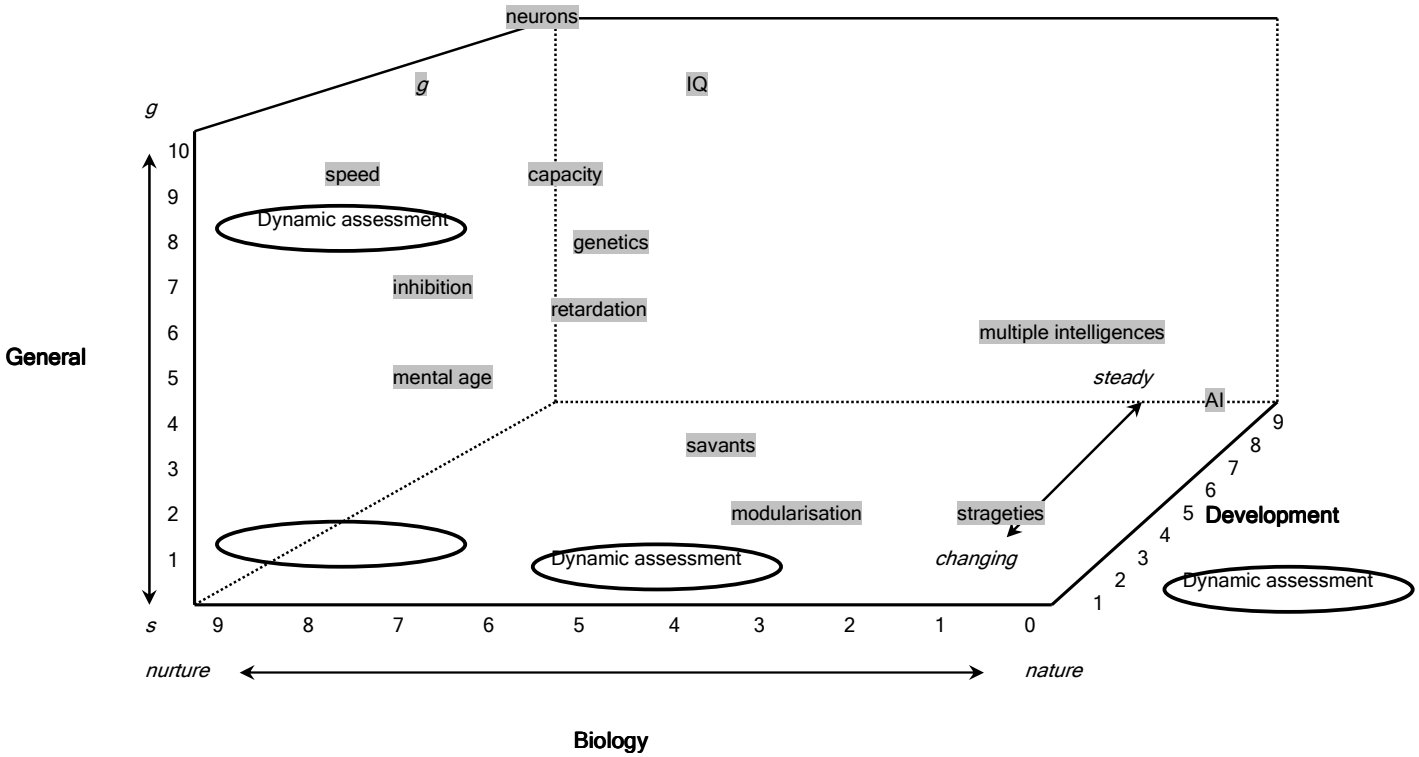
Our intentions are of course academic and scientific and the preoccupation with the nature of intelligence is, it seems, quite typically human behaviour, or is it? It would be wrong to state that it is only the Western countries that pay particular attention to intelligence but it would not be wholly incorrect to state that they do emphasise the notion rather heavily, yet most cultures evidence a recognition of the notion of "intelligent" behaviour (Woodcock, 1998). Having preceded this section with a brief digression into Russian psychology and the role played by Marxist thought may lead one to ponder the role of capitalism and how this has shaped the West's eugenic past and one-time much maligned obsession with levels and degrees of intelligence pivoting notions of retardation and normality (Hodapp & Zigler, 1999). Intelligence and as some would have it, learning potential (Taylor & Richards, 1990), is not a unitary concept (despite the authors' leaning towards reductionist research traditions[142]) (Carroll, 1994; Horn & Noll, 1994; Hunt, 1992; Miller & Vernon, 1992). Somehow it seems to appear unitary at times (or at least very general) and possesses a life of its own, one whose trajectory is almost impossible to pin down even with the most skilled and computationally sophisticated operations; its scope is, in essence too broad (Baltes, 1998) and attempts to engage with a definition from this viewpoint is seen by some to be futile (Horn, 1998b). The need to refine this large base is understandable if one is grapple with a complex phenomenon (Eysenck, 1998). In similar vein to what will proceed below when change based item response models are considered as possible solutions to the gain score issue within classical test theory, it can clearly be seen that much intelligence argumentation takes place within the arcane realm of sophistry where the deployment and

[142] It is difficult to accept that one's preference for a definition rests on something akin to Eysenck's (1998) "error-free transmission of information through the cortex" (p.71). This definition is no doubt very plausible and most likely correct in its circumscribed task of assessing the transmission of error and information through the brain but there just has to be more to intelligence than that! However, as Horn (1998) states, much current biological research can serve an overwhelmingly important role for instance in trying to determine why fluid intelligence decreases with age. Is it possible that decreased blood flow to certain areas results in the loss of relatively quick functioning? Perhaps lifestyles, he adds, should be assessed to help reduce the loss of functionality brought about from the normal aging process.

implementation of sophisticated tools allows special entrance into the labyrinthine and detailed world of nothing other than a face validated extant reality. This is all there is when one considers what intelligence is. We simply do not know. All our tests are based on an initial assumption (face validated of course) of what it is we presumably think we want to measure (measurement: another complicated and contrived notion which will be dealt with in chapter 4) and early intelligence research was predicated almost entirely on measurement (Valencia & Suzuki, 2001). Measurement instruments aid our endeavours but accounting for unobservables within intelligence makes the task infinitely more complex (Humphreys, 1998). To state this so boldly in a treatise dealing with the explicit placement of dynamic assessment within intelligence is tantamount to heresy. But heresy it will have to be. This is undoubtedly the author's views and the following will deal with more scholarly treatments of what intelligence is considered to be and dynamic assessment's place within it.

As described above, the field of intelligence research is so vast, that it would not be too far off the mark to state that it has one of the longest, richest and most confounded histories in psychology (physiological psychology is included here) and a search for a model which can account for this rich domain is nigh impossible. However, to atone for this rather academically ungracious attitude, figure 16 below is presented which at least encompasses the major aspects within intelligence assessment as presented throughout its officially documented Western-favoured history (1904, the year of Binet and Spearman's practical and theoretical contributions; Brody, 1992; Cattell, 1998) as well as its general preoccupations today. This model also fulfils the dual function of allowing one to place dynamic assessment alternatives within it.

Figure 16 Anderson's (1999, p.5) terrain of intelligence in which three principle axes are delineated according to which placement of various forms of intelligence are situated



Unfortunately this figure does not bear a true resemblance to the one of Anderson (1999a) whose illustration shows the three-dimensionality of the various placements in terms of gradations.

Here, in the figure above, the placements have been situated on a two dimension map. Dynamic assessment has been placed along each of the three axes as decided upon by the author and not Anderson (1999a). Regarding the "general" or structural axis, dynamic assessment assesses for skills that are both domain general and domain specific for which there are batteries developed to assess for such skills. Feuersteinian dynamic assessment mediates general skills and prefers to veer away from scholastic type activities as intellectual potential is more easily accounted for within generalised cognitive and metacognitive skills possessed by all alike regardless of cultural context (Mandel, 2002; Paour & Cèbe, 2002). Domain-specific or curriculum-based assessment ties in very closely with specific skills required in certain contexts hence dynamic assessment's placement at both poles of the continuum on the general axis. The truest predictor of performance within a highly specific skill is to assess for precisely that skill (Horn, 1998a) which of course does not define intelligence in any way, merely the skill to perform adequately

the task assigned. If you want to assess piloting skill in an Airbus 380 then it would be best to assess for this skill in an Airbus 380 regardless of test bias (in fact it is strongly suggested that the test be very biased indeed)! On the other hand, assessing for general cognition for placement in educational programmes is rather more general in scope and hopefully less biased and the requisite roles played by specific abilities in the former is of far greater importance than general intellectual functioning as expected in the latter (Snow, 1998a).[143] Regarding the "biology" axis, dynamic assessment practitioners and researchers view both nature and nurture as equal contributors to the development of intelligence on average even though research within both the social environment and behaviour genetics realms are often at odds (Scarr, 1998a). However, various specific traditions align quite closely to one of both poles. This is merely an average representation. Regarding the third axis, "development" dynamic assessment tends to view the individual as changing, which is perhaps its defining feature within intelligence. Due to its acknowledgement of the necessity to co-exist alongside static intelligence assessment philosophy it is not placed at zero or one but rather at two along this axis. Traditional conceptualisations of intelligence are plotted to the upper left of the figure where dynamic assessment would most likely lodge itself at the bottom left. Recall that dynamic assessment is a manner of assessment and is not a theory of intelligence,[144] however, it is so closely aligned with intelligence research that the two are often difficult to pry apart. Dynamic assessment is not a theory or model of intelligence but a model for the assessment of changing individuals which encompasses notions of intelligence development. This rather fuzzy area is one of the many aspects of this field with which some may find it difficult to work. Anderson's model is notable for its inclusion and integration of both high and low level approaches towards the study of intelligence, for *g* it is at once recognised but cognisance is taken of development and growth noting that adult intelligence and child development are not necessarily represented by the same construct (Gardner, Kornhaber & Wake, 1996).

2.8.4 Omnipresent issues within approaches towards intelligence research

Various factors play in on the study of intelligence and have an overwhelming influence on the basic philosophy underlying anyone's basic idea of what intelligence is supposed to be. Issues yet to receive consensus:[145]

(i) Developmental issues are still not sorted out (is development stage-based or punctuated with large scale changes or is it a continuously smooth progression of change?). This impinges on measurement theory (chapter 4) as well as the gain score issue within classical and modern test theory where models have and are being developed which try to navigate around the problem of what the construct of intelligence or potential in fact is. Measurement is paramount to the discussion on intelligence because this is the manner according to which we describe psychometric intelligence within psychology and how and why we measure and subsequently takes us back to fundamental science practice within global science (see chapter 3). The bridge between sound theory and measurement seems to have broken down (assuming it was ever intact in the first place) (Styles, 1999) as theory alone will not suffice as adequate explanation of intellective behaviour (Hunt, 1995). Quantification plays no larger a role within psychology than in the area of intelligence hence the very pressing need to establish and understand more fully the rules and regulations governing what is and is not measurable and if measurement is in fact possible at all. Prior erroneous assumptions of "physical to psychological" led pioneers down a path (not to be snubbed) which was to diverge and crack at certain points along the way (Styles, 1999). The need to bridge the cognitive-psychometric gap is also a feature of newer models of modern test theory which tries to grapple as best it can with constructs evidencing change and so borrow concepts from the cognitive realm and fuse it with the psychometric realm. Intelligence cannot be divorced from the context in which it routinely appears and so environmental and developmental concerns cannot be partialled out of the search for adequate assessment tools (Ackerman, 1994). Bio-ecological theories of intelligence and their psychometric counterparts are at times viewed with suspicion in terms of their renderings of *g* and the role this should or does in fact play within assessment (Ceci & Bruck, 1994). Nevertheless, the current trend is to veer towards developmental explanations of behaviour and intelligence (Wahlsten & Gottlieb, 1997).

(ii) Biological issues are also still not sorted out although in fairness to most researchers, much modern literature seems to have abandoned the 1970's dichotomy as a weak or even bad one at that and is now emerging as nature via nurture (Hay, 1999). It is a great pity yet also a great example of how human behaviour has been so troubled with misconstrued genetic heritage debates. Right questions wrong methodology vs. versus wrong questions right methodology! Will the two ever converge?

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[143] It just so happens that *g* is in fact a better predictor of pilot and navigator training than lower-order factors (Miller, 1990). But hopefully the principle of what was stated above has been noted!

[144] Although reference is often made to models of dynamic assessment as theories of intelligence (Rothman & Semmel, 1990).

[145] It is not the author's intention to be pessimistic about the field of intelligence research (otherwise a thesis would not be written) but the contention is that the wrong questions are being asked of the field. Research simply cannot deliver on the questions being asked. Perhaps they are being formulated incorrectly for it is surmised that in ten years, one hundred years time or even longer, if we continue to ask these questions in the manner in which we currently ask them, the development of research findings in this area is going to continuously frustrate researchers. This comes back to the general frustration with the current understanding of what it means to study psychology - are we talking about mental or physical? Hence the need to discuss this aspect in chapter 2, which is also elaborated upon in chapter 3 and 4. It seems that psychology has forever been involved in some sort of a crises. Is it not about time to move on and try to resolve the crisis by splitting the hitherto unmanageable domain of "psychology" (whatever that means). Intelligence research as well as dynamic assessment will no doubt be the better for it.

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A related aside. The constraints of our architecture within computation and its similarities to the constraints of our prevailing understandings within intelligence research

Attendant to this question of the methodology/research terrain question: looking at the status of artificial intelligence research where strides continue to be made yet are severely hampered by the tools of the trade. Information, at the heart of computation, is still organised and conceptualised in a discrete manner befitting a mechanistic framework of information storage. Scientists utilise this current underlying architectural foundation as point of departure for just about everything else in the field. So at the outset one is constrained by the system in which operations take place. The problem of modelling the human brain (or any other brain for that matter) is not speed as much as it is storage capacity but also how information is manipulated – the brain is not a binary operated machine. The tools of the trade are not in keeping with the entity under discussion because it is the very entity that we cannot yet explain so how are the tools to keep pace? Intelligence assessment tools cannot keep pace with the substantive entity known as intelligence functioning in reality. Can we perhaps move out of the architecture and into completely new architecture which will thus inform the tools of the trade? No matter how sophisticated the tools of computation they are premised on a narrow construal of what it means to store and manipulate data; something is either on or off, a one or a zero. Coming down to this micro level it becomes starkly evident that our underpinnings are extremely unsuited to the types of modelling with which we seek to engage. What is the answer? And how would such a revised foundation function and what would be its characteristics? All the more reason to computationally model brain functioning from a biological perspective (and in keeping with reductionist trends, a physical description would be better, yet too narrow). Perhaps our thinking in this matter is itself too narrowly defined.

However, the physiological psychology literature is still saturated with research findings on these questions. Dynamic assessment has stood steadfast along the lines of continuous change within the individual which reflects back on the developmental issues above. It is assumed that although childhood change is rapid and stage-like, continuous change reigns throughout life, otherwise what would be the point of dynamic assessment's wonderings into adult and geriatric assessment? Similar environmental surroundings, so the logic proceeds, should result in similar outgrowths of intelligence development but the constraining effect of genetic heritage may play against this assumption. Which of the two determines the course of events? Are we asking an impossible question seeking an impossible experiment? This thorny and highly contentious debated issue is precisely so because of the melding of physical with psychological in which physical explanations are sought for psychological phenomena: the crisis in psychology and a theme which recounts its own unending and repetitive cyclical nature. As Humphrey's (1994) states, the task of psychology is after all to explain behaviour not cognition per se; all the more reason to question the sub-discipline's status. Dynamic assessment rests upon a change-based philosophy of intellect and the literature is very much divided on the question as to the differential and changing effects of both genetics and environment on the developing individual throughout life; does genetic contribution wear off or increase over time? There is evidence to cite the relevance of both (Hay, 1999) and the source of much of these results emanates from twin studies (Brody, 1992; Charles, 1973; Horn, 1998a; Reznick, 1997; Reznick & Corley, 1999; Rodgers & Rowe, 1987; Stankov, 2004;) and family constellation set-ups (Galbraith, 1983; Jensen, 1998b, Locurto, 1990; Loehlin, Horn & Willerman, 1997; Scarr, 1998a; Valencia, Henderson & Rankin, 1985; Wilson & Matheny, 1983). Yet substantial research has posited the case for heritability estimates to increase over time with a concomitant decrease in shared environmental influences[146] which also encompasses community influences on cognition which is mediated by parental genotypes (Chipuer, Rovine & Plomin, 1990; Coon, Carey & Fulker, 1992; Jensen, 1997; Loehlin, Horn & Willerman, 1997; Petrill, 2005; Plomin, DeFries, McClearn & McGuffin, 2001). The crux of the argument here is the role of variance accounted for through genetic predictors and not the role of genetics per se, and paradoxically, as age increases and fluid scores of *g* decrease the cultural environment comes into its own as supportive aid (Lövdén & Lindenberger, 2005). The case is indeed very strongly in favour of intelligence being resultant from hereditary more so than on environment. This is particularly the case of high-risk environments where genotype-environment interaction highlights the role of heritability in intelligence estimates (Asbury, Wachs & Plomin, 2005) especially tests which load higher on *g* (such as verbal tests; Gignac, 2006) which generally account for higher heritability variance (Wainwright, Wright, Luciano, Geffen & Martin, 2005). One need only peruse the literature in this regard to agree with this statement (Fletcher, 1991). Moreover, and something which is continuously reiterated in this study, is the recognition of the effect of genetic heritage on socialisation theories, which is mentioned far less in comparison to socialisation theory and its effects on behavioural genetics (Scarr, 1997, 1998a). Yet one cannot ignore the data which attests to the well-known Flynn effect and how mere exposure to technology and education results in elevated levels of IQ or ΔIQ (change in IQ per decade; Jensen, 1998b) (Blair, Gamson, Thorne & Baker, 2005; Flynn, 1998). It

[146] The proportion of variance accounted for by genetic traits when compared to the proportion of variance accounted for by the rest of the criteria. This does not mean that "intelligence is inherited to the degree of 50%" rather, intelligence test results and their associated variance is accounted for by the variance within the genetic traits variance to a ceiling of usually 50% accounted-for variance. It is imperative that these two sentiments are not equated (which they often are, at least tacitly within some literature).

must be recalled that IQ tests assess for those aspects commonly found in technological and educational areas! One should not confuse this issue. Figure 17 puzzles over increasing IQ scores as this has philosophical implications as far as this study is concerned in terms of construct validity for both intelligence and dynamic assessment.

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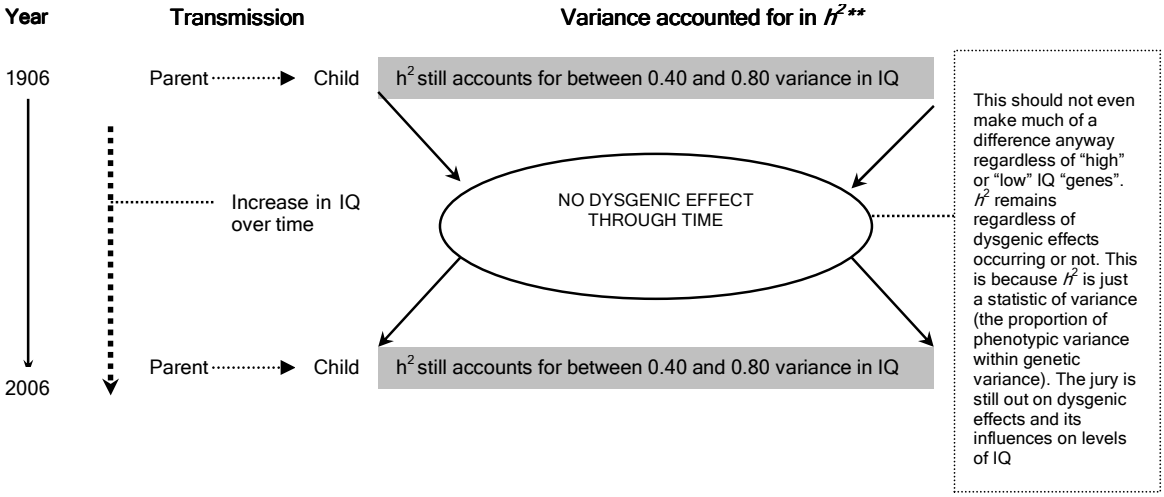
Figure 17 The puzzling increase in IQ and the resultant implications for construct validation



** recall that h^2 is a quotient stating variance accounted for by generational contribution which is genetically transmitted but genes are resultant from evolutionary genotypical-phenotypical influences; so the environment did indeed have very much to do with selection of genes within populations. One can almost declare the irony inherent in the "genes only" argument. The opposite of dysgenic effects would be eugenic effects where the traits are indeed carried through successive generations (Jensen, 1998b), hence the once popular eugenics movement

h^2 still accounts for the same variation in IQ regardless of the IQ score itself. Something is pushing up IQ and it cannot be concluded that more IQ-savvy individuals are being born due to choosy mating strategies (as there are fewer high IQ parents today in comparison to low IQ parents). Hence, genetic influences are not pushing up IQ levels. The nature of the tests has remained the same. Therefore:

1. same h^2
2. same test
3. different IQ

what has changed in the interim?

4. the environmental influences perhaps (cognitive, technological, nutritive and so on)
5. therefore, IQ is in part dependent on environmental influences
6. but IQ is supposedly a pure measure of a theoretically stable construct unadulterated by environmental conditions
7. so we had better re-look our
    a. notions of theoretical and empirical constructs
    b. ideas of immutable IQ measures

however

8. twists and turns pervade the argument and include the following

    a. variance in gains in test-retest scores are not accounted for by *g* (for the sake of the argument it is assumed that *g* = IQ for the moment)
    b. the increases in IQ are accounted for mostly by the lower half of the bell curve where decreasing variance has been evidenced
    c. dynamic assessment predicates are founded on manifest change brought about by enhanced environments (via mediation predominantly) and usually although not exclusively concentrate on those in the lower half of the bell curve

        i. dynamic assessment should thus affect this section of the curve more so than the right hand side (which it does)
        ii. dynamic assessment predominantly intervenes at the level of the environment
        iii. could it be that dynamic assessment results too have increased over time due to the same factors resulting in higher IQ scores? Due to sub-test similarity it should but due to reliance on mediation as variable this relation may be difficult to detect
        iv. as is argued elsewhere in this study; IQ simultaneously does and does not equal learning potential
        v. if dynamic assessment's concern with environmental aid is strong; then there should be concomitant increases in scores on dynamic assessment batteries too (hypothetically testing immigrants in 2006 and 1906 via dynamic assessment may well evidence gains)
    d. once environments are homogeneous in terms of exposure dynamic assessment will likely fall away as the only variance yet to be accounted for will be h^2 (if the logic above is followed and applied here too)
    e. it can also be argued that IQ and dynamic assessment methods are measuring the same environmental influences; added to this is the one common test used in both static and dynamic assessment - the Raven as best current indicator of fluid *g* (IQ)

9. IQ's have increased but h^2 has remained stable so it can also be argued that IQ does still measure a stable construct after all; a shift to the right for the entire curve (and it possibly is not so, merely a deceased variance in the lower end as already mentioned) does not logically imply that IQ is not assessing for a stable trait (*g*). Is the variance decreasing for those in the right hand side as well?

(iii) General and specific intelligence conceptualisation is perhaps the most contentious issue (McArdle & Woodcock, 1998) for which a partial solution has been advocated above in chapter 2 and is developed in chapter 3. The discipline of psychology should split into various streams as competing methodologies and philosophies are incompatible and have as a result only confusion and dissent. This is not good science practice. Physiological research (minimal cognitive architecture and neural speed research which is not knowledge-dependent and hence cannot serve as a definition for intelligence but may well indicate a correlation with it; Guttman & Levy, 1991) should continue unabated (however unpalatable to the more systems-oriented researchers who prefer to witness development and change as emergent). Notwithstanding the advantages of just such a tradition, systems orientated models of change and development need to continue within their own stream. Emergent properties are by their nature inherently unpredictable,[147] Three main views which have permeated the disciplines' writings concerning intelligence are monarchic, oligarchic and anarchic models (Sternberg, 1998). A single global monarchic form of intelligence is most likely correct in formulation but is inadequate when practically explored. Oligarchic concepts view intelligence as consisting of broad factors (which is also most likely correct as it really only is a sub-set of the former with most of the published test batteries available addressing fewer than a hundred primary dimensions; Horn, 1998a). Lastly, anarchic models, which view intelligence as incredibly multifaceted (also correct to a point but very unwieldy and so specific that one tends to get lost in the morass of abilities which seemingly goes against the tide of parsimony within science research – see chapter 3). Scarr (1998a) emphasises the role of theory within socialisation and behavioural genetics research where competing theories cannot be said to predict and control for everything as it would thus not be testable nor could it be inconsistent with itself (Styles, 1999; Torff & Gardner, 1999). Of course the very same critique can also be levelled at a grand framework which seeks to encompass everything in life! A bio-psycho-social-genetic-environmental model is equally as absurd in detailed reality but less so in conception. The debate surrounding *g* is infinite and links up to the notion of construct validity as discussed in chapters 3 and 4. Dismissing the construct debate and forging ahead with measurement technique is a rather pointless activity yet it seems to consume much of measurement psychologists' time. Horn (1998a) states with regard to *g* that it has yet to meet three pivotal requirements for a suitable scientific notion:

- The requirement of a similar factor – that is *g* should be computable across different groups
- The requirement of a unifying principle – that is how lower order factors tie back into *g* (and for which *Gf-Gc* theory posits no unifying *g*; Wilhelm, 2005)
- The requirement that *g* should relate to other variables in a consistent fashion (here we see the construct validation argument)

But a theory of *g* can also attest to the following (Bowman, Markham & Roberts, 2002):

- The existence of a positive manifold – intelligence tests correlate in a lawful fashion as first evidenced by co-variation noted by Spearman (Anderson, 2005b; Neisser, 1998); high scorers on verbal tests similarly score highly on spatial and numerical tests (Borsboom & Dolan, 2006). *G*-based theories are the single most persistent theories in the intelligence literature (Blair, 2006; Morgan, 1996) and one has to consider this itself an indication of its validity in some form or another; after all, general ability "represents a broad construct that underlies non-specific information-processing efficacy" (Ackerman, 1988, p.290). Whether or not such positive manifold can be equated with psychometric *g* (recall that it is itself a statistical concept) is debateable (Heitz, Unsworth & Engle, 2005).
- The stability of *g* across test batteries – regardless of factor rotation, the underlying constructs remain; although one can argue that factor analytic approaches are merely one type of statistic which require support from structural and nonfactor analytic evidence (Flanagan & McGrew, 1998). Also most tests would correlate as many are inevitably constructed within one reigning paradigm
- *G*'s real-world utility value is great (this is clear even within layperson interpretations and understandings of intelligence; see figure 11 above). Regarding the utility value of intelligence tests per se, studies have evidenced that of the top ten utility value ranked standardised tests within the educational counselling domain, four were intelligence batteries (Esters & Ittenbach, 1999) which most likely alludes somewhat to the generality of *g* given its statistical appearance across tests
- *G* evidences meaningfully empirical correlates (clearly a pro-Jensen view[148] which is contested by many researchers)

The counter-arguments against the above are detailed in critique and offer tantalising arguments to the contrary nature of many *g*-based claims. *Gf-Gc* theory and models derivative of this theory attest to *g*'s somewhat partial existence yet also affirm its fluid nature when attempts are made to capture it. Perhaps one may refer to *g* as evasive, similar to visual illusions where concentric circles appear to move but upon looking directly at them they appear stationary.

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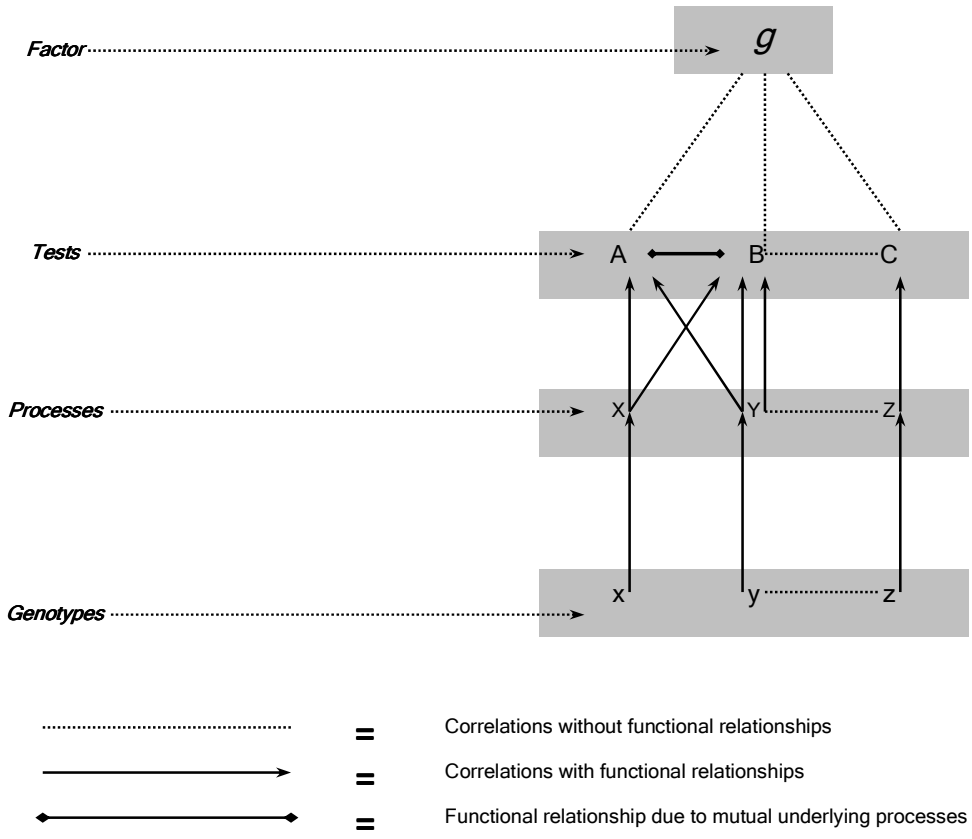
[147] The author can imagine the backlash of criticism to this statement.
[148] Arthur Jensen. Mogens Jensen, a firm advocate of dynamic assessment should not confused with Arthur Jensen.

Recall that *g* is a positive manifold psychometric construct (statistical, think Binet) not a biological one (not completely validated as one just yet and not proven as a substantial theory, see chapter 4 for more on the difference between substantive and hypothetical constructs; think Galton) (Bowman, Markham & Roberts, 2002; Detterman, 1994b; Hunt, 1998). Jensen and others contest this (1998; Brand, Egan & Deary, 1994; Deary & Smith, 2004; Demetriou & Papadopoulos, 2004; Li, 1996) by favouring *g*'s biological nature (Baron, 1985) with suggestions that the prefrontal cortex is very important in *g*-related tasks, although not exclusively so (Duncan, 2005). However, Jensen has in the past maintained *g*'s non-reified nature (1969). The issue surrounding *g*[149] as both a statistical and psychological construct is contentious (Lohman, 1996) after all "how do we proceed to endow *g* with meaning?" (Borkowski & Maxwell, 1985, p.221). Jensen's (1982b) depiction of the relations between *g* and tests, processes and genotypes in the paradigm of reaction-time research is illustrated in figure 18 below. Recall that genotype is a result of a continuous process of modification brought on by phenotype-genotype interaction and mutual influence which is not shown in this figure. Reaction-time research (RT) evidences differences in all populations including sub-normal populations which yield differential reaction times within groups so that correlations between RT and *g* are commensurate with level of intellectual functioning. Jensen (1982b) is at pains to emphasise that RT is not necessarily a component of *g* but that it relates to it is evident. RT is able to discriminate between low and high IQ populations which attests to its functionality and utility. Learning potential too is able to discriminate within a narrowly defined range as evidenced in the early studies conducted by Milton Budoff and his colleagues in the 1960-1970's with educable mentally retarded and educable educationally retarded individuals (Budoff, Meskin & Harrison, 1971). Both these groupings were originally considered one group of uneducable individuals. Their work was also concerned with biopsychological substrates which were far from irrelevant in their furnishings of additional information into interactions between other levels of descriptors within cognition (Snow & Lohman, 1984).

Figure 18 Jensen's (1982b, p.270) depiction of g's relations to tests, processes and genotypes in the reaction-time paradigm



This typifies the swing of the pendulum within constructions of intelligence; "the psychometrics of intelligence tests and the psychology of human intelligence" (Lohman, 1997a, p.372). Here it can be seen that the struggle between different approaches towards one area can lead to vastly different conceptions; for within the structural understanding of intelligence "much is known

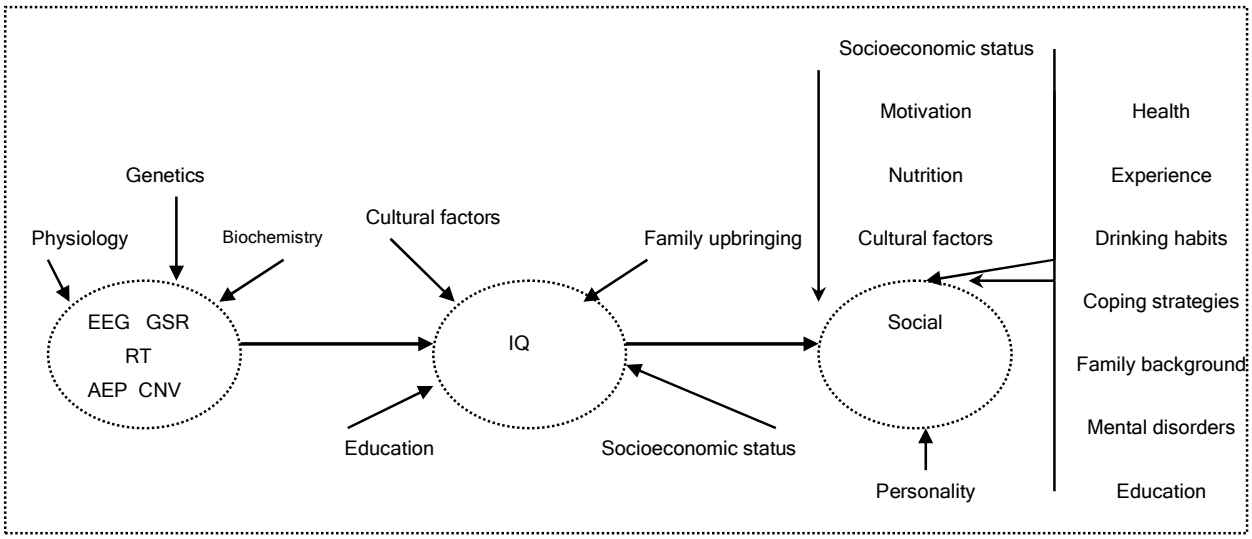
[149] *G* arises from correlations, pure and simple. This implies its statistical rendering. However, it seems to arise more often than not thus indicating (not stating, merely indicating) its substantive nature.

about the taxonomy and predictive validity of human intelligence differences, [but] there has been relatively little progress in understanding their nature" (Deary, 2001, p.127). *G* is perhaps assessed during some instances and not others although logic would dictate that a governing or underlying pervasive structure such as *g* should indeed be manifest at any level. The degree to which modules in the brain can function without the need to inform themselves of other modules (multiple intelligences or modular theory; Gardner, Hatch & Torff, 1997) ("relatively autonomous intellectual competencies"; Krechevsky & Gardner, 1994, p.287; Wellman & Gelman, 1992) is no justification for the fact that *g* operates solely in isolation from other areas in the brain. What we cannot see is the nature of the underlying mechanism at work within structures in the brain and behaviour although evidence suggests that both neocortical and the more evolutionary primitive areas of the brain developed specialist localised interconnected sets providing support for modular-like intelligences (Barton, 1997). Looking at the issue from a biological or psychometric perspective colours the very conclusions that are drawn. Hence, say some, the need to revisit the issue from a systems perspective where the global emergent nature of the set-up is assessed. This brings one back to the case for reductionism and hence the need to branch off in different directions in order to piece together the fabric of brain functioning and behaviour. The author will not belabour this point any further, but suffice it to say that *g* most likely exists in some form (Detterman, 1998a) (perhaps not psychometrically feasible in some instances but this is a methodological fault on the part of human researchers and not evolutionary processes that are unwilling to yield their secrets!). Butterfield (1998) betrays his allegiance to a *g* form of intelligence when he succinctly states that all intelligent systems learn, but more intelligent systems learn more yet he does emphasise the ability to learn (including metacognition) as crucial in locating for intelligence some adequate defining criterion. This brings us firmly into the terrain of levels of description.

2.8.4.1 Levels of description

Explaining levels or hierarchies of description (Gleitman, 1985) are necessary if researchers (those trained within the behavioural and natural science spheres) are to adequately account for or at least offer tentative explanatory models of behavioural and testing outcomes. This is so because each level necessitates level-specific theories and assumptions based on physical and structural functioning of the brain and behaviour (Changeux & Dehaene, 1994; Changeux & Konishi, 1987; Chipman, 1986; Davis & Anderson, 1999; Hunt, 1998). Hunt (1992) refers to three levels regarding theories of thought; namely, the physiological (brain-based), architectural (the way in which information is processed) and knowledge-representational (semantic concepts) levels. Champions of such approaches have long advocated the need for more integrated analysis of the system (Churchland, 1986; Churchland & Sejnowski, 1996; Neufield, 2002) and although not embarking on a dynamic systems analysis of what it means to be human, a favoured approach within this dissertation is to adapt both a view from above and below (high and low levels). After all, each level of analysis offers its own insights into the workings of a domain of interest or research (Stillings, Weisler, Cahse, Feinstein, Garfield & Rissland, 1995) with the subsequent recognition that no single level reveals the whole story (Klivington, 1986). However, the focus within any one discipline for obvious reasons neglects to study the detail of another, which is one such method of globalised science practice. Ignoring any view is acknowledged to be dangerous (Thelen, 1994) and as such inclusive co-investigatory procedures should be undertaken within the study of intelligence and specifically dynamic assessment interventions, as it is so often the favoured technique utilised within sub-populations of patients requiring specific treatments as discussed above. No anxiety should accompany any specific research agenda housed within its own tradition, for as Neisser (1997) states "we need not fall prey to post-modern cynicism, and we are in no danger of being eliminated by our neuroscientific friends" (p.258). Eysenck's (1986) model is similar to the notions of cross-boundary disciplines aiming towards a fuller more inclusive understanding of intelligence and is depicted in figure 19 below.

Figure 19 Eysencks' (1986) model of the relation between biological, IQ (psychometric) and social intelligence



Neurophysiological, anatomical and behavioural studies of the human brain at once permit and firmly bar the study of the organ at various levels, ensuring that the lone researcher will not quite be able to grasp the full functioning organ at one level only (Gardner, 1998). Hence the need for multiple-angled studies stressing multiple points of investigation into one phenomenon at various points in time (Chugani, Phelps & Mazziotta, 1994; Huttenlocher, 1994; Nowakowski, 1994; Oyama, 1994). Epigenetic growth within the individual comprises so multitudinous a network of reactive genetic responses to impinging environmental stimuli (or lack thereof) that selecting matched age cohorts within studies designed to test for any factor, for instance, is immediately prejudiced against a host of cross-pollinating variable reactions which occur at differing times for different people. Reducing to a singular notion a genetic complement within human beings and ascertaining the nature of genotype will not readily reflect anything of use as epigenetic growth is by its nature phenotypical expression based on mutual inclusion of genotype and phenotype (Ceci & Bruck, 1994; Jensen, 1997) which are themselves governed by the environment[150] (Hurtford, Joseph, Kirby & Reid, 1997). Bogged down in such a mire of information necessitates the narrowing of focus within studies purporting to study the ''intelligence'' or ''improvement'' of subjects over time (pre vs. posttest designs) and space (in various cultural settings). The way out of just such a doomed scenario would be to isolate methodologies and goals, but to what cost? Anderson's (1992) view of intelligence is that both low and high level accounts are really working towards the same construct but are doing so in markedly different ways.

Psychometric and laboratory-based approaches towards assessment are often seen to be **low-level** explanatory systems which are concerned with three dominating aspects:

- The increase of cognitive abilities with increasing age
- The stability of individual differences throughout development
- The co-variation of cognitive abilities on a broad range of psychometric tests
- In sum: low level approaches are concerned with intelligence as biologically (genetically) determined attributes of the nervous system (Anderson, 1992, p.2)

Dynamic assessment models, notably Feuersteinian-based ones interface well with bio-ecological models from intelligence research and straddle the link here

High level approaches towards the understanding of intelligence foster the notions of:

- Specific abilities in addition to a general ability
- The universal cognitive mechanisms which are characteristic of everyone
- In sum: high level approaches are concerned with intelligence as governed by culture and is an experimentally driven attribute of cognitive functions (Anderson, 1992, p.2)

Dynamic assessment focusing on improvement over time does so from a behaviourist perspective, a psychological angle lacking in perhaps a more detailed analysis of the amount and type of change undergone at a more neuroanatomical level. For instance, although far more evident and pertinent at very young ages, stages of brain maturation will simply not allow for certain expected resultant behaviours from interventions. This is due to the maturation of the brain at any one particular stage and its allied neuroanatomical development (Diamond, 1994). Who or what is to say that delayed development or inadequate stimulation at critical periods counter efforts to increase scores on psychometric tests? Interventions at age six might only be reciprocated by increased scores at a later age, even though age-relevant tasks are mediated for this age group.This being wrongly interpreted however, might lead unquestioning investigators to assume that intervention was a failure due to task-intrinsic factors or that the model of development and so forth. The reason will not necessarily be found on a behavioural level but well within the neural level.

Regardless of the explanatory level reason offered, constraining and/or inclusive experiential stimuli will also play an overwhelmingly large role in determining (not always dictating) the next step in the progress of the individual, whether behaviourally or neuronally (Johnson, 1994a). As such, this too has to be included in the conceptual framework when considering the what/when and how of interventions within intelligence settings. Maturation (think Vygotsky's learning) and experience (think Vygotsky's instruction) are co-evolutionary (Churchland & Sejnowski, 1996) and there is no one-to-one linear relation between the two (Greenough, Black & Wallace, 1994) displaying a continuum of cause and effect between maturation and environment. One need think only of the interaction and difficulty of pin-pointing effects of education on IQ and IQ on education. Does having a higher IQ elicit education-seeking behaviour or does increased education access stimulate higher IQ? (Retherford & Sewell, 1989). Gene expression can be altered by exposure to environmental stimuli (Kennedy & Dehay, 1997) and gene expression can result in certain experiences being sought; for instance over-production of neurons results in their eventual pruning and thus allows for more practicable allowance of neuronal density in the developing brain (Huttenlocher, 1994; Nowakowski, 1994). This blending of levels should take place when answers are not forthcoming from within other allied levels.

Questions at one level will ineluctably lead to queries bombarded at higher and lower levels within the same area of description (Churchland, 1986) notwithstanding the now-tiring debate between radical materialism, epiphenomenalism and dualistic interactionism as to the constituents of mind/brain (Eccles, 1989). How models are built determine in part their explanatory power, as such, functionalist models will assume linked functions of the various tiers or hierarchies of study as mentioned above[151] and structuralist approaches assume that the way in which a system is built yields different information. To allow one a seat at the table of viewpoints does not necessitate adherence to any one particular approach to the study of intelligence for instance. Casting a conceptual net over any viewpoint will result in being cut off from other fertile areas of pursuit. The question raised is whether it really is a good idea to forego old notions of narrowly focused conceptual fields of enquiry when the full landscape of possibilities is open to use by broadly focused areas. Bridging this gap will allow more confluence within seemingly disparate areas of interest (when in fact these ''disparate'' areas are at times quite closely aligned). Melding two or more areas of focus (the level of analysis) can only be more extensive as opposed to not allowing some sort of coalescence,[152] Intelligence assessed from psychometric and structural approaches allows for aspects such as attention and memory (Messick, 1996) to be viewed as correlatory to a general level of intellective functioning and is perhaps conceptually easier to study from this vantage point than perhaps a biological point.

Both micro and macro systems, as illustrated by the neuronal and behavioural levels of explanation respectively offer glimpses into functioning which simultaneously also limits our understanding of the complete unit. It would appear that a four dimensional analogy would suffice to elaborate on the predicament in which we find ourselves, being unable to explain events at one level without sacrificing the modes of explanations at another level. In order to visualise a hypercube in our three dimensional existence, we are forced to visualise its three dimensional shadow, a somewhat frustrating experience, allowing access to what it may look like and even allowing us the luxury of pursuing it's shape within the mathematical realm (Rucker, 1986), but never affording us the opportunity to probe it closer. So it is with the various levels of description which are necessary to invoke as alternative manners of gaining access to how the brain functions, but not allowing us the similar luxury of being presented with the full picture. It lies tantalisingly close within our grasp but our meta-theoretical framework seems lacking in a fundamental ingredient. An overarching conception? What would it look like? Without pseudo-characterising brain studies as quantum systems,[153] the situation is very much akin to only being allowed to know the momentum or position of an electron at any one time, but never both! Is there not perhaps a way in which the system can yield all information at various levels without ceding

[151] Even though these conceptions are merely to make life easier for the researcher, it is not evident that nature has in fact arranged matters so that we may view them through functionalist/structuralist frameworks. Our shaping of the framework and continual reshaping allows us to pursue the same questions in different contexts as well as ask different questions within one context. Whether this is good or bad is not the issue as it is unlikely that it can be construed as good or bad as this is value-neutral territory.
[152] To each his own. At our peril! Remaining focused but forsaking the need to correlate or map onto other levels of description is a dead-end.
[153] An oft-quoted critique levelled at Penrose (1999), in which it is speculated that cells ''somewhere deep in the brain'' (p.517) are assumed to function as quantum systems. However, it does seem as if Penrose is merely utilising a provocative thought experiment to illustrate his point.

necessary information? This endeavour resonates with intelligence research within dynamic assessment, as change is evident but the level at which it occurs is difficult to ascertain. Once the change has occurred it is nefariously difficult to trace its origins. The experiential and/or native domain is offered as arenas in which change is orchestrated within the human. How sure can researchers be that change is in fact induced via environmental stimuli and not as a result of an epigenetic flowering? (Karmiloff-Smith, 1994). This selectionist view, which accommodates both the preformist (enlarging of an already nativist or formed organ/cell) and empiricist views (the blank slate or constructivist view) is ever-more sanctioned by both neuroanatomists and psychologists alike (Karmiloff-Smith, 1994; Nowakowski, 1994). Although subject-area specific jargon is used to describe similar concepts (empiricist vs. constructivist), the re-directed attempt in understanding the full system posits a more inclusive methodology towards the study of how the brain adapts, functions and changes over time. Dynamic assessment's emphasis on process as opposed to attainment (same score different paths getting there) is thus perhaps closer to a more modern understanding of intelligence assessment after all (Glaser, 1998; Snow, 1998). Yet process analysis is still much poorer in information than the traditional conceptualisation of intelligence as content-based (Humphreys, 1998) with current static-based intelligence assessments making headway in allowing for the assessment of underlying cognitive processes rather than abilities (Harrison, Flanagan & Genshaft, 1997).

This is the main point within this section, namely that ''change'' evident at the behavioural level need not be evident at any other level, hence undermining the efforts in inducing such change. The permanency of any such change needs to be investigated at other levels beyond the macro behavioural. Perhaps it is helpful to designate levels of description within this pre/post test set-up so as to materialise efforts at distinguishing where in fact the so-called changes are taking place, at what age, at which location in the brain and how manifest this change is. Not all manifest change is however permanent and neglected change at the micro level may be of more use at certain critical points in development as well as within assessments aimed at dynamically testing people across domains. Figure 45 (chapter 3) illustrates Madsen's (1988) conception of a similar stance taken on the relation between model and experimental object (the brain) and fits well within the Churchland and Sejnowski (1996) depiction of the understanding of physical sub-systems within the larger system of the brain.

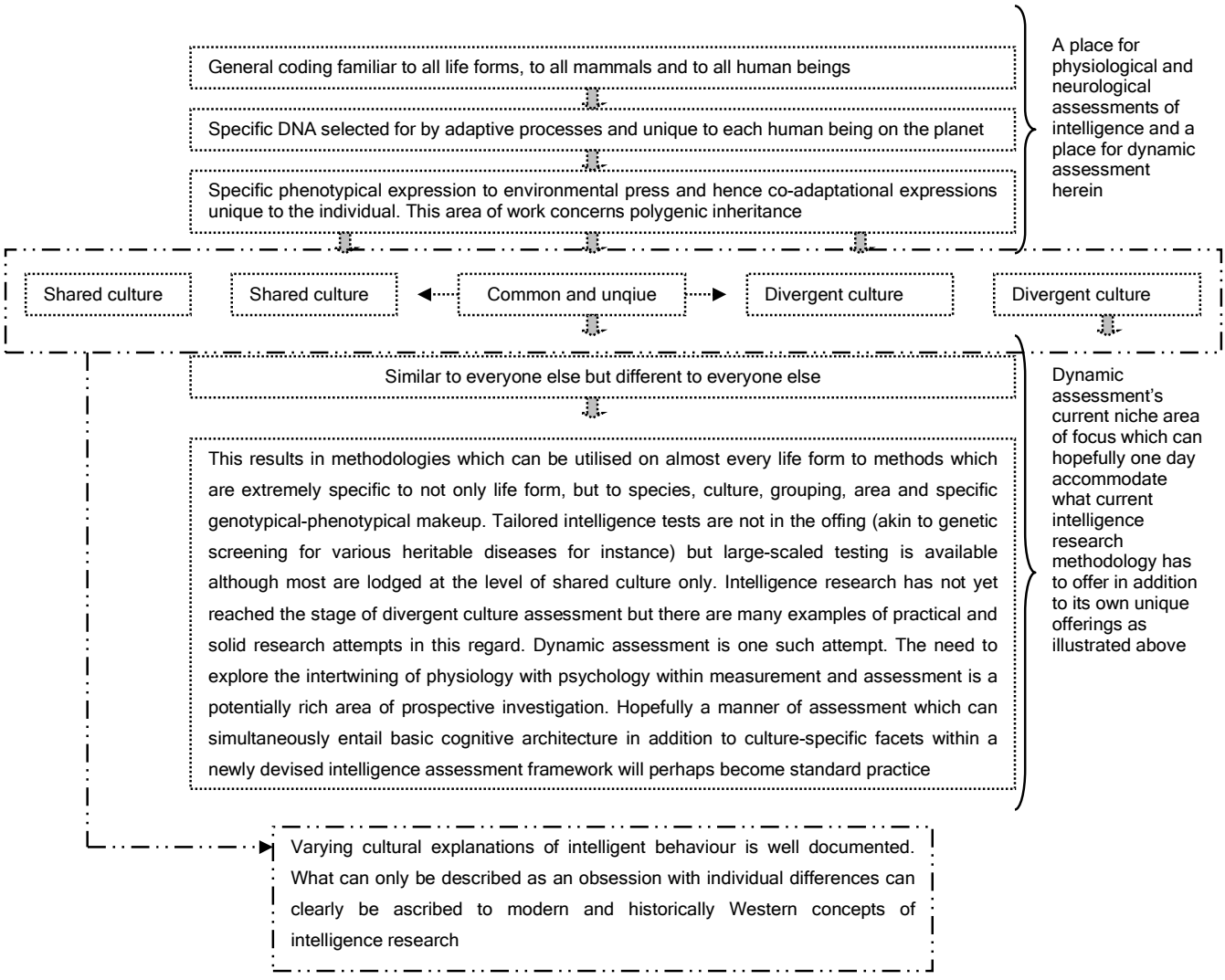
(iv) The issue of culture which is prevalent in dynamic assessment research comes to the fore but on a scale further down the continuum. The need for some to place emphasis on intelligence and the manner in which this is done differs radically from culture to culture as well as the emphasis placed upon individual and group differences (Davis & Anderson, 1999). Intelligence can be considered so narrow a feature of existence, that pigeon-holing it into specific contexts is about as accurate as one can get states Berry (1998) whose cultural concerns are pervasive when attempting the study of intelligence. Intelligence is appreciated only as it pertains to the culturally understood meaning of what it means to act intelligently and how society is likely to treat people (Detterman, 1998b; Pellegrino, 1998). Such an argument can only go so far in today's world where the global arena is pervasive and will most likely result in even greater homogenisation. Human beings can be simultaneously viewed as being enclosed in and enclosing various layers of social and individual functioning. This can be viewed as follows in figure 20 below. If the aim of dynamic assessment is to make available a context for the opportunity to improve on current level of functioning so as to address resident yet non-manifest performance, can one state then, that it's aim is to improve performance? If this is the case, then it is not a short leap between performance in general and performance on an intelligence test for instance. This smacks of the rallying call for attempts to raise intelligence (Spitz, 1999) which, if alignment with a biological perspective is taken becomes more untenable as a research effort. Unless, of course, biological predisposition can be moulded of which phenotypical consequences bespeak. This is a particular instance of where we might perhaps be asking the wrong questions or utilising the incorrect methodology for the question. It is unlikely that *g* is malleable but its various tendrils including metacognitive reserve are perhaps malleable. If *g* is indeed not malleable where does this leave intervention programmes included among them of course, dynamic assessment and its attendant mediation strategies? What exactly is being mediated? Cognitive skill, metacognition and behaviour which are then construed as non-*g* factors (because *g* is by default unalterable just as DNA coding is unalterable[154]) in which case the effort is useless (far transfer usually does not result for instance but near transfer is possible, as often cited).

The magnitude of the transfer of skills learned as a result of mediated learning within global dynamic assessment depends on the nature of what is being mediated; metacognitive information may transfer further than specific skills such as spatially demanding skills (Snow, 1998a). Closely aligned to transfer is the related concept of maintenance; the degree to which information is retained and applied in novel instances but is itself ascribed to intelligence (Campione, Brown, Ferrara, Jones & Steinberg, 1985). In other words, the higher the initial estimate of intelligence the greater the likelihood of far transfer and increased maintenance which brings researchers back to the point of origin in terms of intelligence and potential. The point is that depending on how the nature of intelligence is construed the nature of mediatory intervention should be tailored accordingly but due to the uncertainty still prevalent within intelligence in psychology, leaps forward will most likely be hindered by undeveloped understandings of what and how mediation works. Perhaps the reason as to why far transfer so rarely occurs is

[154] For now the author will ignore recent research attempts to molecularly alter genes.

because the underlying mediated or remediated trait is not altered which if argued back again means that the target of dynamic assessment interventions are targeting *g*-type skills. However, this does not close the gates for remediation and mediation research because interventions can at least ameliorate the effects of low performance due to any number of reasons (Anderson, 1999b; Horn, 1998a). The question is how best to go about doing this. Cattell (1998) cites research which indicates that fluid intelligence suffers as a result of damage to the brain regardless of the area of injury whereas crystallised intelligence is more resistant to such change, which loops back to the former statement of mediation affecting non-cognitive or metacognitive skill.

Figure 20 From the specificities to the generalities of intelligence assessment - where dynamic assessment can invent its place



A number of evidential criteria as to why vertical and horizontal depictions of intelligence are correct are offered and include results from brain damaged individuals which attest to the sole functioning of areas of the brain which are then able to accommodate for the loss (Nettelbeck, 1999). Research results emanating from the loss of functioning in the brain as well as from mental retardates has proven a fertile area of knowledge gathering within intelligence research (Horn, 1998a). The fact that savants are able to perform the feats they can; the research emanating from experimental psychological tasks; the support from psychometric measures; a history of development which can identify end-state performances; the reflection of evolutionary processes and their resultant consequences; operational sets of information processing activities and the propensity for the symbolic encoding of information all manifest in identifiable separate modules or intelligences (Reznick & Gardner, 1999). When conceptualising for global intelligence research and multiple forms of intelligence, along with other modular theories and *g*-theories, would it not seem possible to state that all these models are merely snapshots taken at different angles of the very same construct? Fluid (cognitive mechanics) and crystallized notions (cognitive pragmatics) of intelligence, *g* and *s* versions of intelligence, socio-environmental and behavioral genetic considerations and much else besides inflames the agenda with facets which seem almost to burst at the seams (Li & Kunzmann, 2004). A finite number of sets of intelligences can at least constrain the system in which all sets work together in a complex system (Detterman, 1998a) which, as with Gardner's multiple intelligences brings us back to omnipresent *g* (Li, 1996). None of the models are wholly incorrect and none are fully inclusive and encompassing of all there is to know, but one gets the feeling that that much research within these so-called opposing traditions are in fact looking at the same construct from different views. Each has much to offer but the attempts to glue together this tapestry is where the difficulty arises.[155] The concept of Anderson's (1999) minimal architecture infused with growth of developmental modules (akin to Fodor's modularity of mind which does not account for development of these modules) is an instance of an attempt to assemble various views on intelligence. Increasing development of modularization is a manner of side-stepping this issue. The fact that *g* underlies supposed modular functioning is contested as modularity presupposes distinct functioning capacities and performances (Nettelbeck, 1999) but if the view of *g* is taken to be one of substantial underlying foundation then this conception of modularity has to be revised. Not all approaches are however greeted with their original degree of enthusiasm as many early notions of information processing for instance have long since outlived their utility (Reed, 1997).

2.8.5 Yesteryear and today – how far have we come?

The journal of educational psychology convened a panel of intelligence research experts in 1921 to collate various opinions regarding the nature and future of intelligence and its research endeavours; entitled "intelligence and its measurement". One will read with humour and humility the aspects highlighted by these venerable scholars of over 85 years ago for much of what they say has hardly changed in the interim yet there have been staggering improvements on a number of fronts, not least concerning physiological understandings of brain functioning. Embretson's (2004) comments on the future trajectory of research within this domain echo similar sentiments and places particular emphasis on the fact that the future bodes well for the further refinement of techniques and concepts developed during the latter half of the twentieth century.

"The value of a test score is its value in prophesying how well a person will do in their intellectual tasks" (Thorndike, 1921, p.125). Given the specific weighted task at hand, states Thorndike, will allow for better detailing of a person's functioning on that task but to search for perfect correlations between specificities and to relate this back to a general level of intelligence is almost impossible unless each separate task is assessed and as we know there are too many sub-tasks to assess. This very same issue still poses problems in the defining of intelligence today (Baron, 1998). Just as there were serious misgivings as to a general factor in 1921 so too are their similar misgivings decades later (Ruml, 1921). The awareness and clarity already present so early on in the history of intelligence testing in terms of differentiation between the substantial and hypothetical nature of the construct is testament to the slow progress that has been made (Pressey, 1921). The end goal of assessment was and still is a practicable one; in other words seeking to aid versus seeking to characterize; the former being of central concern within dynamic assessment. Sufficient time and practice expenditure (assuming unlimited time and resources) will undoubtedly improve upon naturally possessed faculties. In order to ascertain intellectual functioning, the correct weighting, sampling of persons as well as domains will need to be accurately computed. After this is complete we are still no closer to defining what it is we are looking for. Thorndike (1921) concluded his contribution by stating that more research was needed! Terman's (1921) understanding of intelligence centered around the proportion or degree to which abstract thought made up intelligence functioning. Scaled utilization of intelligence tests was deemed a notable advance in assessment but still the need to consider intelligence in its multifaceted make-up is a theme within Terman's conceptualisation of intelligence. Simply put, passing a test of intelligence means nothing other than the fact the test was passed. Freeman (1921) concurs and empahsises the importance of an inclusive

[155] Abbott's (1992) Flatland perhaps offers the easiest analogy here: two dimensional beings are unable to conceive of three dimensional beings and so exhibit frenzied fits upon the sight of three dimensional characters in their own two dimensional world. Instead of seeing three dimensions (a circle) they perceive merely a planar section. Taken from different angles, an intelligent flatlander will be able, in time, to piece together the myriad images into one whole unit. Can intelligence research not attempt the same?

definition of intelligence stating that an individual can be bright yet unintelligent. Depending, of course, on how one views the context.

Fully inclusive tests obviously do not exist and the multiplicity of tests available in 1921 led Colvin (1921) to lament the vast array of domains available for testing and he was also in agreement with the notion of intelligence not being a unitary factor. The author's own stated definition of intelligence given above is perhaps a definition that strikes an immediate intuitive appeal for lay people and scholars alike, for is adaptation not the hallmark of human life? Adapting to niches within the physical and cultural environment has enabled human kind to successfully navigate through time and space. Adaptability was proffered as general definition on intelligence by many scholars (Pintner, 1921) and includes the degree to which one is modifiable as Pintner (1921) states "… this leads us back to the general modifiability of the nervous system" (p.139). Is this not what dynamic assessment advocates? Brown and Campione (1998) pick this up in their assessment of the changes (if any) that intelligence definitions have undergone since the symposium. What has really changed in the intervening 85 years since statements such as these were uttered? The retort to the argument of general adaptation to the environment is that it hardly proceeds beyond general differences which is not the task set aside for individual difference researchers requiring finer levels of discrimination between individuals which is typically the area with which intelligence research concerns itself. Yet group difference intelligence research plays a primary role in synthesized research results across the spectrum and is perhaps even more contentious than individual difference research (Wittmann, 2005). Pintner (1921) himself recalls the "horror" of masses of intelligence research publications emanating during the first decades of the twentieth century and noting that a movement of "back to basics" resulted from the plethora of research results. Here we find ourselves back to basics 85 years later (Scarr, 1998b). There is clearly something amiss.

Over sixty years later, another panel of experts convened to discuss the nature of intelligence and the progress made since the 1921 symposium (Sternberg & Detterman, 1988). A number of loci of intelligence was considered as framework axes and included three main strata: the individual, the environment and the individual-environment interaction. The individual axis includes the biological, molar and behavioural levels. The environmental axis includes the level of culture/society; level of niche within culture/society as well as level x sub-level interaction. Each of these in turn describes a number of sub-categories within themselves and is testimony to the structured development and nature of intelligence research since the early decade of the twentieth century (Sternberg, 1988). Figure 21 illustrates this in-depth framework and considers much of what constitutes essential ingredients in the intelligence debate.

Figure 21 Loci of intelligence (Sternberg, 1988, pp.4-5)

Individual

- *Biological*
  - Across organisms: between species (evolution), within species (genetics) and between-within interaction
  - Within organisms: structure, process, structure-process interaction
  - Across-within interaction
- *Molar*
  - Cognitive: metacognitive (processes, knowledge, process-knowledge interaction), cognition (processes such as selective attention, learning, reasoning, problem solving and decision making; knowledge and process-knowledge interaction), cognition-metacognition interaction
  - Motivational: level of energy, direction of energy and level-direction interaction
- *Behavioural*
  - Academic (domain general and specific and general-specific interaction), social (within person, between persons and within-between interaction), practical (occupational, everyday living and occupational-everyday living interaction)
- *Biological-molar-behavioural interaction*

Environment

- Level of culture/society (demands, values and demands-values interaction)
- Level of niche within culture/society (demands, values and demands-values interaction)
- Level x sublevel interaction

Individual-environment interaction

Estes (1998) maintains that the oft-repeated question of what intelligence is, is rather old in terms of expecting an advanced answer and prefers to ask the question of where intelligence is now as opposed to 1921. Rather than attempt to continue with a question with no answer, it would perhaps be best to pursue other avenues of information pertaining to intelligence other than within the traditional grounds of psychology such as artificial intelligence for instance, an aspect not considered in 1921 (Schank, 1998). The major defining features between the construal of intelligence in 1921 and current renditions, is the former's emphasis on equating testing with intelligence understanding (although not exclusively so) and current conceptions of intelligence as far broader in scope and less preoccupied with the predictive nature of intelligence and more concerned with the nature of the

construct (Sternberg & Berg, 1998). Although this second point of concern is particularly contentious as doing away with intelligence measures of any sort is highly likely to reduce the predictive validity of a substantial number of intelligence and selection test batteries (Wilhelm & Engle, 2005). Similar debates abound in their current form much as they did in 1921 such as the unitary nature of intelligence (Detterman, 1998b) although there are moves towards regarding aspects such as metacognition and the like.

2.8.6 Cognition

Intelligence research is often subsumed within cognitive studies which includes, among other areas, artificial intelligence, neuropsychology, computational intelligence, cognitive science, social cognition, cognitive education (and specifically its relation to dynamic assessment; Lidz, 1992b), cognitive psychology and the increasing awareness of cross-disciplinary research[156] (Fetzer, 2002; Harnish, 2002; Jordaan, 1993; Potter, 2000). It has been questioned as to whether this grouping is necessary or even correct (Hunt, 1998) as the boundaries are often blurred (Boden, 1988). As with intelligence, cognitive psychology also appears fragmented without an agreed upon all-encompassing definition of a model or theory of cognition (Conway, 2005) which is cause for concern as the cognitive mechanisms underlying intelligence are considered the tools through which intelligence research progresses. Dynamic assessment is a manner of psychological assessment thus placing itself in the arena of cognitive psychology which is itself placed within the realm of cognition. Cognitive studies thus include an impressively wide array of focus areas including neurcognitive, behavioural, psychological, neuroanatomical and computational research (Ochsner & Kosslyn, 1999). Housed under the realm of cognitive science, dynamic assessment should lend itself to the rigours of the cognitivist approach which itself has opted for a more natural science inclination towards study and research (Strube, 2000). Evaluating the future of cognitive science warrants a level of analysis encompassing all aspects of cognition and in so doing affords an ecological frame of reference, through which cognition's past and future can be evaluated. This ecological level of analysis inherently claims that no one particular field of investigation seeking ultimate explanation can in fact carry our such a mandate, yet it would seem that current endeavours in neuroscience are attracting seemingly larger advocates of biological/physiological explanations of cognitive functioning. Neisser (1997), a proponent of just such an approach asserts that an either-or approach to the study of cognition will result in limited understanding and renditions of what is purported to occur cognitively. Asserting that the strides made thus far in terms of brain functioning within neurology provide lucid and at times contrary evidence to that provided by more traditional cognitive theories, does not necessarily imply the future abandonment of psychological theories or the usual model-building approaches towards cognition (Donald, 1997).

As a research science, cognitive psychology cannot hold sway over the entire discipline of intelligence with which it is intimately linked predominantly due to the fact that very much the same problematic issues beset the field as they do with intelligence: the transient link between theoretical and empirical construct. Jensen (1998b) refers to this matter thus "the vehicle is not the construct; the construct is not the vehicle" (p.309) which in sentiment can be traced back through to the level of empirical construct and this is derived from the measurement instrument.[157] Within the last fifty years, psychology has been the continuous product of a confluence of disparate enterprises culminating in broad-ranging theories and models and owes much of its cognitive repertoire to the research areas dominated by, among others, Chomksian linguistics, neuroscience, computational theories and ethology (Potter, 2000). The history of intelligence assessment is bound intimately with the history of cognition and the two can hardly be delineated as distinct enterprises which makes for the demarcation of these sub-disciplines very tedious. Most burgeoning areas within cognitive science (cognition) occurred within the twentieth century (Posner & DiGirolamo, 2000) after foundational psychometrics had been laid, hence the need to briefly consider cognition. The psychometric model which emphasises the measurement of individual differences encompass theories which are based on patterns of relationships among test scores. The information processing model typically emphasises precise theories of how cognition occurs; and specific tasks rather than broad generalisations are studied. The cognitive developmental approach emphasises commonalties between people rather than individual differences. All three have overlapping similarities but major differences characterise their unique approaches (Kail & Pellegrino, 1985). Perhaps greater attention can be paid to instructional influences on cognition and the brain and how dynamic assessment can be positioned to tentatively test within this approach (Ashman & Conway, 1997; Beatty, 1995; Friedman & Cocking 1986; Walters & Gardner 1986).

This very short digression into cognition serves only to place or situate intelligence research as sub-discipline. There are numerous overlapping areas which concern intelligence and some areas which do not share similar agendas. Hence there will be no discussion, bar a fleeting reference to the very broad field of cognition. Where some insight is necessary however, is within the notion of bridging principles already discussed above in section 2.4.5.3.2 and to be discussed again in section 3.4.2.1

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[156] At times, these terms are used synonymously and interchangeably and at other times are used to delineate differing meanings.

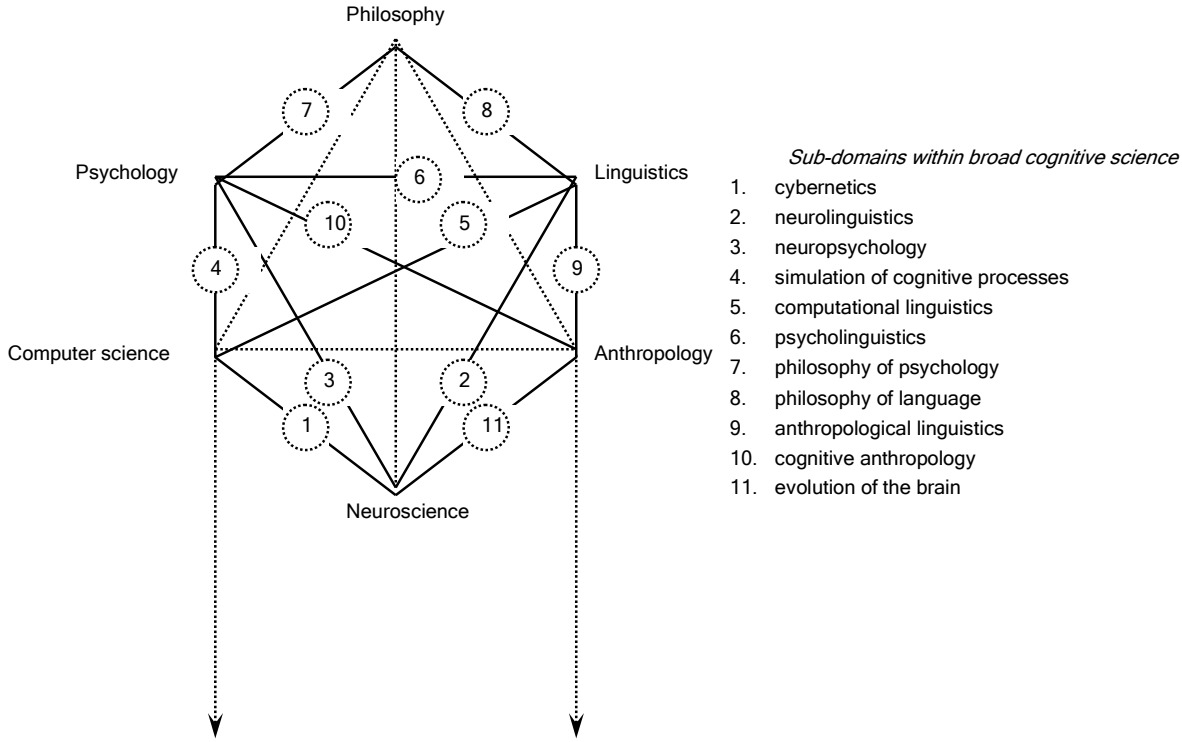
[157] Jensen (1998b) argues cogently for the stability of psychometric *g* even though it has been shown that IQ levels are on the rise (performance IQ not verbal IQ) with a concomitant decrease in scholastic test results. This poses somewhat of a problem when thought of in terms of both instruments' *g*-loadedness. Jensen's argument is that *g* has not changed, but rather the vehicle through which such conclusions are drawn. Since measurements are dependent on the instrument, these measures will thus change. Hence, *g* is manifest through instruments which evidence measurement. There are areas of concern for all three aspects as is argued in this thesis.

below. The link between isomorphic renderings of psychological-neurological understandings of brain/behaviour is a recurrent theme within this thesis. The notion pops up once again in this discussion within cognition. Various theories and models of cognition allow for the brain to be modeled and understood in terms of systems representing mental states whilst other models construe the brain as very much brain-like, such as connectionism or parallel distributed processing (PDP) for instance (Jorna, 1995; McCauley, 1998) which models the physiological brain in a similar manner (Green, 2001). Research into the connectionist models of cognition came to the fore in the 1980's (Green, 2001). The connectionist computational theory of mind and the digital computational theory of mind are both positioned under the more generic computational theory of mind which itself is viewed as part of the older representational theory of mind (Harnish, 2002). The confluence of many sub-disciplines within intelligence research may seem overwhelming in their capacity to discover much more about human functioning than in any era before the present and the need to link research findings across disciplines could be construed as a bad move. Max Planck[158] once referred to the acceptance of ground-breaking science as a very slow process, only being accepted by the new generation as the older generation die off - perhaps we are in the midst of a new paradigm within intelligence research and are not yet aware of it. According to Hunt (1997a) cognitive science is simply a revisionist attempt at looking at the intelligence paradigm, a paradigm which Woodcock (1998) suggests should start to reduce the lag behind cognitive science. Once again, any view necessarily has to be constrained lest the domain of focus becomes overwhelmingly complex resulting in too large a theoretical conception of what is being studied.

There has been a progressive move away from behaviourist renderings of the "mind" (positivism) towards the cognitivist view of brain (realism) where the former denies access to what it cannot sense and where the latter, via the hypothetico-deductive method of science investigation (see chapter 3), attests to the brain's further discovery (Harré, 1997). However, the situation reflective of the contextualised/decontextualised development models noted in the psychological literature (Piaget and Feuerstein for instance) is reminiscent of the parallel developments within the cognitive sciences in which various aspects are considered decontextualised and others contextualized. This above-mentioned move away from behaviourist towards cognitivist renderings of human functioning is often viewed as a standard dichotomy (Spiker, 1989) within the broader field of cognition but may well be a normal path of progress along which the discipline of cognition and cognitive psychology travels. The so-called cognitive revolution may be a misnomer and was moreover confined to the United States (Bechtel, Abrahamsen & Graham, 1998; Mandler, 2002). Nevertheless, along with a renewed approach towards the understanding of cognition-in-context (situated cognition) is the similar move towards ecologically valid understandings of human performance within educational and social environs especially in the area of cognition and learning contexts (Glaser, Ferguson & Vosniadou, 1996a) and away from laboratory-based results of human performance. This is much in keeping with current dynamic assessment trends and tenets representative of sociocultural approaches towards education and its attendant technologies (Dillenbourg, 1996). Learning takes place within interactional contexts and not in isolated situations (Vosniadou, 1996b) and even if there is no human mediator present, the system of tools mediates much of what is learned. Piagetian developmentalist notions are understood within an abstract framework within which development occurs (domain independent) as opposed to Feuersteinian notions of culturally dictated or collaborative frameworks (domain independent) (Mendelsohn, 1996). Vygostkian notions have made their presence felt over a very broad spectrum of application within education and education technology such as the ZPD's transference into scaffolding concepts (De Corte, 1996; Day & Cordón, 1987; DiLalla, 2000; Dillenbourg, 1996; Kanselaar & Erkens, 1996; Mayer, 2001). Donald (1997) insightfully depicts this relation in his comments on how artificial intelligence, cognitive psychology and Chomskian linguistics was supposedly to have supplanted its decontextualised forbears, but ended up speculating in very much the same vein. Time and again, researchers are confronted with levels of description upon which their opinions and data need to be leveraged for anything to make sense. No sub-domain as yet managed successfully to answer all questions, least of all because we simply do not know most of the answers, but more so due to this inherent limitation within the scientific method. Nevertheless, science and cognition within it forge on in what Donald (1997) hopes will be representative of an integrative approach and not a reductionist one. Figure 22 illustrates the various domains within cognition research and how most, if not all, have become subsumed within the larger domain of intelligence assessment including dynamic assessment.

[158] In fact Planck (1858-1947) hailed the year 1900 as the year of transition between classical and modern physics with the discovery (origin) of quantum physics. Quantum theory, itself revolutionary, had yet many years of development ahead of it before it was accorded status of "new paradigm".

Figure 22 The cognitive hexagon (Pylyshyn, 1983, p.76): cognitive science's boundary transcendence



- The philosophy-psychology-linguistics triad has played a substantial role within the roots of Vygotskian dynamic assessment
- The psychology-computer science-neuroscience triad has brought to light much emanating from simulation studies
- The psychology-anthropology-linguistics triad has brought to the study of intelligence assessment the issues of culture and language
- There are a variety of such similar triads and dual links that can be sourced from the hexagon model of cognition

Such constraints however, bring with their own limitations such as the utilisation of the computer metaphor as analogy for the brain. One major limitation in understanding how the brain functions and learns when viewing it within the computer analogy is it's dependence on a recursive argument and the fact that the brain's biodynamic architecture is very much unlike the architecture of a binary representation of information (Pascual-Leone, 1997). It is more like the neuropsychological models based on neural nets (Anderson, Silverstein, Ritz & Jones, 1977; Cilliers, 1990) emphasised over thirty years ago. The computer metaphor is a product of our thinking and is of course merely a snapshot of how we think we operate and as such we proceed to base and compare findings to the computer analogy thus further narrowing our understanding of how the brain functions, after all we are basing our functioning on a model that is partly derived from this very functioning, so then is it not a limiting analogy of which to make use?[159] As Broadbent (1958 in Shotter, 1997) states "we are trying to model man, and yet there is a man in the model" (p.324). Computational psychologists are not computer-model-mind followers necessarily but do share some similarities with computer-analogy theorists of perceptions (Boden, 1988) as to how the brain functions such as the

- Adaptation of a functionalist approach to the study of the brain in which psychological process are viewed as procedures
- Conception of the brain as a representational system
- Link to neuroscience in terms of understanding the functional relations via neurology; i.e. how logical operations are carried out within a neural network framework

[159] Likewise with the pioneering work conducted in artificial intelligence, but here at least one is not confronted with a back-to-forward view of the brain in terms of the computer metaphor. Linear functioning artificial systems are of course not in the same league as the functioning non-linear brain (Warwick, 1998)

However, computational systems struggle to map the learning and development process as it is not even fully understood within the biological realm of study. When positions such as these are proffered it is done so often from a meta perspective in order to frame the argument. That there are similarities with intelligent functioning in humans such as the processing of relations for instance is not in question (Halford, 1999). Yet such a completely solipsistic argument allows one no-way out of such a muddle and though hard-pressed to ignore the argument in favour of just such a view even thinking about a way out is considered as time better spent pursuing other avenues. Such a view will not aid in the discovery of how the brain develops and changes, and a healthy dose of such solipsism is taken under consideration but is not an avenue this thesis seeks to wind its way through (Bates & Elman, 1994).[160] Formal computational thought models are extremely useful but only as one of many nested metaphors for describing psychological states where progress on a number of fronts can be made within simulation environments and then brought to bear on reality.

By our computer analogies, we are only depicting a narrow conception of how we think we operate, which is to be expected, as the partial reasoning behind this exploration is to further elucidate our own functioning, which is then reflected back to us for more interpretation and so on. This computer-reductionist approach is referred to as the hard cognitive science assumption,[161] an assumption which has been criticised for being too reductionistic and not encompassing of more "subjective" approaches towards such study; but for which for instance Pascual-Leone has offered a tentative remedy[162] (Pascual-Leone, 1997). Although critical of the hard cognitive science approach, Pascual-Leone does state that computer metaphors involving programmes and theories serve to illuminate how certain cognitive functions occur but mental processing itself encompasses this computational approach as well as broader, more explicable theories of how the mind works (including his metasubjective explanations). In other words computational processes (as described by the hard science metaphor) only yield partial glimpses into the nature of the mind's psychological functioning and although it can and should be utilised (in describing psychological processes) it should be used in conjunction with the more complete armoury of metasubjective tools[163] to study these processes. Notwithstanding these reservations it must be noted that computer science has influenced theory and methodology within the information processing approach (Reynolds, 1987). This includes the strides made within other areas of investigation where computational simulations elucidate (and at times are able to predict) closed and open system behaviours[164] (Dennett, 2004), and are capable of serving as an interface between traditional cognitive assessment and neuroanatomical models of functioning (Neufeld, 2002). Norman (1988) explicitly states that the architecture of the modern digital computer was a result of humans' conceptualisation of how the mind in fact operated and to view the computer metaphor as a limited comparison may well be founded, but that it was an original[165] conceptualisation of "mind" must similarly be kept in mind (d'Ydewalle & Denis, 2000)! However, it would seem that research into [computer] engineering and psychology are synergistic in terms of both fields contributing knowledge to the other (Gardner, Kornhaber & Wake, 1996), pointers if you will, in the directions into which certain sub-disciplines should enter. Vygostkian sign or semiotic tool and role of language as sign system has a modern-day ring to it in terms of computational analogies and how computers are based on a system of signs (mark manipulators) such as programming languages but sign utilisation within human language and computational language are fairly far apart in many respects. Within this framework of symbol manipulation and semantic theories of language one arrives at the static difference between computers which manipulate marks as opposed to humans who process signs. Another framework dictates the algorithmic rule-based system which computers follow as opposed to human non-algorithmic thought processes and is subsumed under the rubric of dynamic differences. Lastly there is the conception of the new paradigm of simulationist thinking which comprises simulations, emulations, replications and emulations via neural networks, connectionist and artificial intelligence research (Fetzer, 2002) which is also being increasingly utilised in statistical analyses of behavioural data (Baker & Richards, 1999; Maree, 1998). Figure 23 illustrates the three framework conceptions.

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[160] See Kleene (1967) who states that according to the Church-Turing thesis there are some values which a machine cannot compute; in other words a recursive function in which something or some machine refers back to its own description (Church and Turing concluded very similar sentiments within the same year, 1936, yet they did so independently; Copeland, 2002). Kleene's own recursive function theory was applicable in the determination of the range and limits of axiomatic systems in mathematics (Mahoney, 1997). Gödel maintained that a logical system might be consistent but never complete and Alonzo Church maintained that it was impossible to devise any algorithm which could demonstrate which theorems were provable and which were not (Rucker, 1987; Turner, 1967). Of interest is the fact that Gödel's metamathematic proof was axiomatised in terms of arithmetic; in other words he was able to provide a proof in the same language for which he was trying to find a proof (Butterworth, 2000); see chapter 4 for more information on axiomatisation.

[161] Here, the hard cognitive science assumption refers to both the older concepts of AI (artificial intelligence) and the newer versions represented by connectionist simulations (Pascual-Leone, 1997).

[162] Pascual-Leone intends remedying this approach by creating for this new confluence of hard and soft approaches to cognitive science a new lingua-franca which is informed by a metasubjective theory; a metatheory which is a "… theory of the observer, but of an observer carefully modelling subjective and objective processes of the 'psychological' organism, not of the computer" (1997, p.79).

[163] Included here are aspects of psychological functioning that have as yet not been adequately simulated by computers, such as affect, consciousness, development and so on (Pascual-Leone, 1997) although with the aid of sophisticated computational intelligence software, 'archaic' programmes such as ELIZA (developed in the late 1960's) are progressing rapidly in terms of the modelling human behaviour (Reynolds, 1987).

[164] Here reference is made to British mathematician John Conway's "Game of Life", "an oversimplified model of determinism" (Dennett, 2004, p.36) developed in the 1960's.

[165] See Norman (1988) in which he states that a host of researchers and academics from disparate disciplines were already engaged in the development of the digital computer ca. 1940.

Figure 23 Three conceptions of computer-mind analogies (Fetzer, 2002, pp.xiii-xvii)

Static difference		**Dynamic difference**		**Simulations**	
Argument 1: Computers are mark manipulating systems, minds are not		*Argument 2: Computers are governed by algorithms, but minds are not*		*Argument 3: Digital machines can nevertheless simulate thought processes and other diverse form of human behaviour*	
Premise 1	Computers are mark-manipulating systems, minds are not	*Premise 1*	Computers are governed by programmes, which are causal models of algorithms	*Premise 1*	Computer programmers and those who design the systems that they control can increase their performance capabilities, making them better and better simulations
Premise 2	These shapes, sizes, and relative locations exert causal influence upon computers, but do not stand for anything for those systems	*Premise 2*	Algorithms are effective decision procedures for arriving at definitive solutions to problems in a finite number of steps	*Premise 2*	Their performance capabilities may be closer and closer approximations to the performance capabilities of human beings without turning them into thinking things
Premise 3	Minds operate by utilising signs that stand for other things in some respect or other for them as sign-using (or "semiotic") systems	*Premise 3*	Most human thought processes including dreams, daydreams and ordinary thinking, are not procedures for arriving at solutions to problems in a finite number of steps	*Premise 3*	Indeed, the static and the dynamic differences that distinguish computer performance from human performance prelude those systems from being thinking things
Conclusion 1	Computers are not semiotic (sign-using) systems	*Conclusion 1*	Most human thought processes are not governed by programmes as causal models of algorithms	*Conclusion*	Although the performance capabilities of digital machines can become better and better approximations of human behaviour, they are still not thinking things
Conclusion 2	Computers are not the possessors of minds	*Conclusion 2*	Minds are not computers		

A refreshing alternative to the hardware computer model of the mind (which hardly does justice to the electro-chemical make-up of the brain) is one which is lauded by Greenfield (1997) as a ''molecular symphony'' (p.82), which, as a real description of how the brain functions, can not as yet be fully described by the prevailing computer models of the brain. Of course it must be kept in mind the level of description we wish to describe (Hofstadter, 1980); be it intelligence models of how human brains recall memory or compute logical analogies, or neural architectures of how the brain physically functions, which encompasses neurochemical explanations. How thought is conceptualised in the brain can be ascertained from tracers in the blood in the brain or can be determined by more global models of thought which are currently the preferred mode of explicating how the brain in fact does function in psychological intelligence models. Which level of description does justice to the manner in which human beings think? At which level should remedial programmes be pitched in order to overcome or redress imbalances in thought processes? At which level outside the system should one even begin to engage in trying to remediate? Environmental or genetic? Hence the need for a more engaged and inclusive dialogue which should be favoured in the new century. This continual lament (Wilson, 1999; Royce, 1973) for an innervated inclusive research programme which will probably still be argued for in decades to come. Until then, the level of description at which remedial programmes are levelled will have to content themselves with lack of information about other levels and an inundation of information from its own chosen level of description. Shall we refer to this all-inclusive level as a 'thick description'?

In sum, the hard cognitive science approach is and should be utilised as a means of explanatory metaphor when analysing mental processing but due to the recursive nature of this tool (in terms of it lacking full self-description) should not be used exclusively within the psychological realm and needs to be combined with more traditional (yet not stale) soft science approaches. This has a bearing on how theories of mind, theories of intellectual functioning and ultimately theories of dynamic assessment are operationalised. Initial research into devising computers though, was based and constructed on intelligent behaviour, information gleaned from research into intelligent systems. In a rather simplistic analogous model, human information processing can be equated with computer processing at a very basic level. Perception in the form of input (visual or audio) is analysed at various levels in humans and in terms of binary digits in computers (although the input may present itself in a variety of forms, the computer compiler translates the varied input into machine readable code), information is then temporarily stored in "primary memory" (Craik and Lockhart, 1972) where it is housed till the immediate task is completed (which may be seen to superficially resemble RAM[166] in computers). Our long term memory storage can similarly be equated with a computer's hard drive (or any removable storage device).

The information processing paradigm or metaphor although having found its predominant field of application to be that of, among others, pattern recognition, logical problem solving and perception (Broadbent, 1987;[167] Kenrick, 2001) has woven its way into more diverse psychological areas of interest including clinical, social, developmental psychology as well as human-computer interaction (David, 2004; Posner in Broadbent, 1987; Reynolds, 1987). Dating the initial presence of any discipline or sub-discipline is not an exercise that can be exacted with precision and certainty, although it is generally recognised that researchers such as Chomsky, Newell, Simon and Miller were at the forefront of this new information processing approach to the understanding of human behaviour and whose pioneering work started to gather momentum in the 1950's (David *et al.*, 2004; Harnish, 2002). Later, Neisser's 1967 text on cognitive psychology helped solidify this emerging field within psychology (David *et al.*, 2004). The study of cognition having begun in the mid-nineteenth century using experimental techniques may be crudely said to have evolved into the information processing approach as the two are at times used synonymously (Reynolds, 1987). Housing the information processing approach within the larger framework of cognition as opposed to seeing the former as a progression of techniques within the latter remains debateable. The move towards mapping brain function onto brain structure witnessed the rapid growth of neuroscience (Harnish, 2002), the level of description more easily attuned to physical reality but because so much remains hidden from view, information processing models often interpret the working model from information that is already known. As has been mentioned a number of times, levels of description are inherently narrowly construed but to effect a cross disciplinary programme, all levels need to be viewed when considering human behaviour in its totality. Most of the above levels of description have one common thread running throughout their research paradigms and that is to represent brain and behaviour in some fashion. Hence, most are representational theories of mind (Harnish, 2002). Digital computational models of the brain are subsumed within general computational models themselves serving under the broader model of representative models. Figure 25 illustrates the representational nature of both neural and mental structures which loops back to the brief discussion on isomorphism within neurological explanations of psychological behaviour (see chapter 2 section 2.4.5.3.2. figure 2 and chapter 3 section 3.4.2.1 figure 34). The explanation of psychological states via neurological models and the subsequent invoking of bridge principles can effect an understanding of brain working and does so within the broader field of cognition under which is housed intelligence and dynamic assessment. The two above-mentioned figures illustrate how behaviour is translated into data via semantic linkages and various empirical and bridging principles as well as rules of correspondence which results in hypotheses. In keeping with the so-called bridge principles discussion, figure 24 depicts Simon

[166] Random Access Memory
[167] Reprint of Broadbent's original 1958 work.

and Wallach's (1999 in Strube, 2000) six criteria of empirical adequacy in order for cognitive models to correctly map from and between computational modes to human behaviour modes.

Figure 24 Simon and Wallach's (1999 in Strube, 2000) criteria of empirical adequacy for correspondence expanded upon by the depiction of the role of bridging efforts

Cognitive model paralleling real life behaviour - six ideal bridging or correspondence criteria	
Product correspondence	Overall performance
Correspondence of intermediate steps	Processing in the model parallels separate stages in human processing
Temporal correspondence	Computation expense parallels reaction-times patterns
Error correspondence	Same error patterns in model and in experimental data
Correspondence of context dependency	Comparable sensitivity to known external influences
Learning correspondences	Identical learning curves

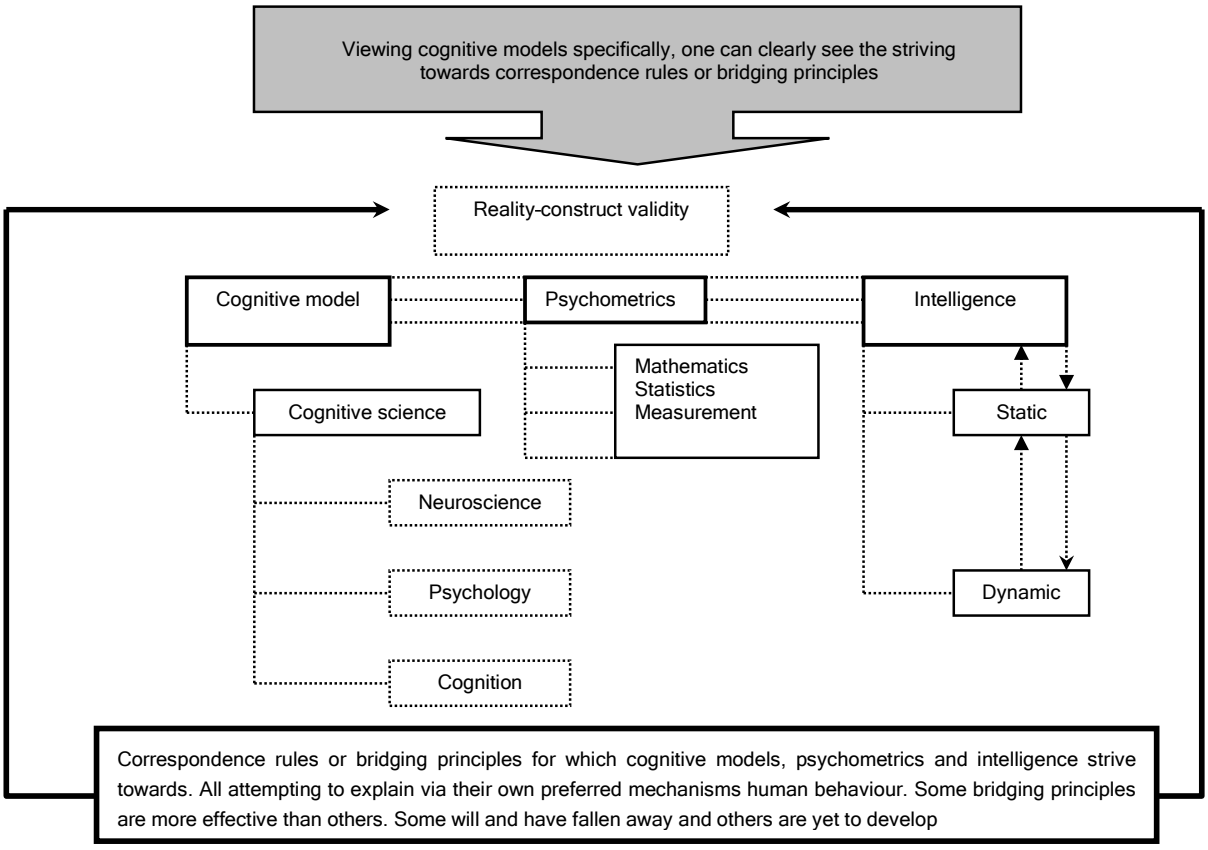

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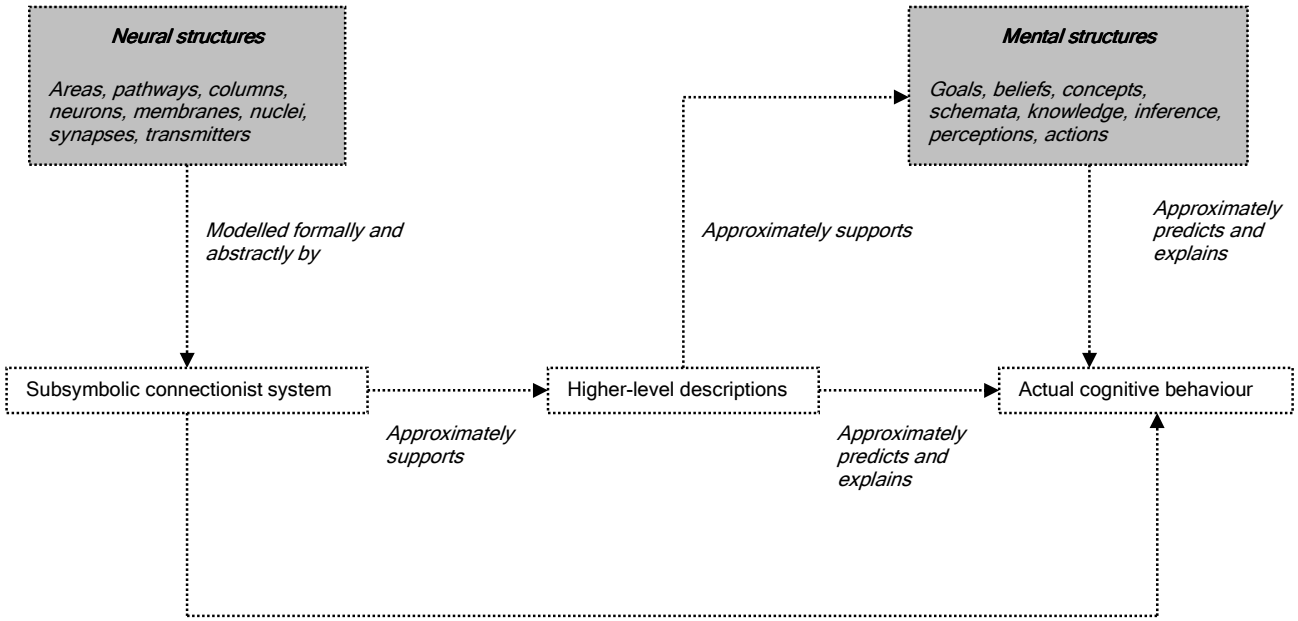
Figure 25 Neural and mental structures in the sub symbolic paradigm (Haugeland 1997 in Harnish, 2002, p.347).



Note the similarity within this cognitive domain illustration and figures 2 and 24.

Computer-assisted assessment - moving steadily into the twenty first century and a niche for the further expansion of dynamic assessment?

The number of dynamic assessment instruments currently available using the computer as medium is steadily increasing (Jacobs, 2001). The efficacy of using different media when attempting to teach in any pedagogical setting has been studied for a number of years (Greenfield, 1987) and has placed emphasis upon the integration of cognitive psychology principles into these media of instruction (Mayer, 1997, 2001, 2002, 2003; Mayer & Anderson, 1992; Mayer, Dow & Mayer, 2003; Mayer, Fennell, Farmer & Campbell, 2004; Mayer, Heiser & Lonn, 2001; Mayer & Moreno, 1998, 2002a, 2002b, 2003; Mayer & Sims, 1994; Mayer, Sobko & Mautone, 2003; Plass, Chun, Mayer & Leutner, 1998). It has for instance been shown that varying cognitive strategies for processing information come to the fore when information emanates from different media such as print, audio or visual media (Mautone & Mayer, 2001; Moreno & Mayer, 1999, 2000, 2002). Dynamic assessment engages individuals within what is understood to be a co-construction (scaffolding) of reality and this principle in turn is utilised within various multimedia learning environments (Herrington & Standen, 1999). Is there really a marked difference between performance using dynamic assessment techniques which have as their medium the traditional paper and pencil format as opposed to performance when utilising computers for instance? The very nature of dynamic assessment is one of learning to learn within any specific assessment situation, so, the argument may proceed, if learning is affected by the medium of instruction, it is feasible to state that the media used in dynamic assessment setting should influence the nature of learning or at the very least strategies employed in the processing of information. Every medium has inherent biases which are prohibitive when using certain information processing strategies, however, it is these very biases which allow for other strategies to be used in turn when assessing for alternate strategies.

- *Print media*

The traditional format of instruction and assessment works well under circumstances where the information that is given requires the imagination of the reader in order to complete the expressed experience but does not promote the use of visual movement (Greenfield, 1987) an area which may be more suited to media which are able to carry the task (such as computers and or television).

- *Audio*

One aspect found in dynamic assessment that does in fact make use of the audio medium in assessment is the hints methodology used in testing-the-limits as means of eliciting correct information processing strategies. Of note is the fact that when analysing audio presentations dialogues and figurative language are understood better as opposed to receiving the information from a visual source (Greenfield & Beagles-Roos, 1983 in Greenfield, 1987). Administering assessment in the testing-the-limits manner might well be more beneficial using an audio format as opposed to a visual one, however, this depends heavily on the aspect that is being assessed, certain types of reasoning strategies may be more easily understood using visual media when encompassed within a testing-the-limits scenario. Each test and sub-test will thus have to be screened for best choice of medium taking into consideration the specific processing strategy that is being assessed.

- *Television*

Information regarding action is best sent via media utilising three dimensions as this information will be better understood in context. Action information is better recalled by subjects when it is sent via television as opposed to receiving it via audio transmission (Greenfield, 1987). Computing technology has progressed to the point of allowing for mastery and surpasses that which is offered via television, hence the greater concern with computers as transmitters of action information as opposed to television.

- *Computers*

Computers are at once exceptionally useful exponents of understanding brain functioning, their explanatory power is evident in the many areas in which they are used to derive analogous functioning of the human brain that it has become increasingly difficult in today's technologically oriented environment not to make use of computing power when understanding the process of learning and of information processing. The role of the afore-mentioned media cannot however be questioned as to their efficacy in terms of their pedagogical roles, however, when computers are able to allow for assimilation of all these media in one, the usefulness of this particular medium becomes evident.

Simulation techniques are able to offer researchers a platform in which "complex systems having multiple, interacting, dynamic variables" can be assessed (Greenfield, 1987, p.19). Whether the translation of pencil-and-papers assessments to assessment on computers makes a difference is one question, but the manner in which this translation is carried out is another. This "mindless" translation between media may well be an area to watch closely (McArthur, 1987).

2.8.7 Non-intellective factors

Non-cognitive factors play a paramount role in intelligence,[168] life/job success or achievement (Cattell, 1963; Grossberg & Gutowski, 1987; Howe, 1987; Watkins & Mauer, 1994), school-based performance as well as dynamic assessment predictive validity and often come to the fore during the assessment situation of average and learning disabled students (Budoff, 1987a, 1987b; Hamers & Sijtsma, 1995; Haertel, Walberg & Weinstein, 1983; Kormann & Sporer, 1983; Miller, 1998; Revelle, 1987; Short, & Weissberg-Benchell, 1989; Resing, Ruijssenaars & Bosma, 2002). The latter group, for whom dynamic assessment is a particular choice of assessment technique (Lauchlan & Elliott, 2001) cannot be treated as a homogenous group and they are often unfairly and disproportionately represented in educable mentally retarded groups (Hamers, Hessels & Pennings, 1996; Harrison, Singer, Budoff & Folman, 1972; Schlatter & Büchel, 2000; Short & Weissberg-Benchell, 1989) just as culturally disadvantaged individuals are not similar in all respects. Hence dynamic assessment's concern for the individual within the group. It has been evidenced that sample groups treated with dynamic assessment interventions may not appreciably differ on IQ tests, learning potential scores or on school marks but differences between such groups becomes more manifest when non-cognitive aspects such as cognitive style, motivation and attitudes are assessed (Babad, 1977). This highlights the need to perhaps be more inclusive of such traits in dynamic assessment interventions as well as more static mainstream assessments. Criticisms of mainstream assessment are directed towards this missing aspect within tests where non-intellective factors are simply not considered (Tzuriel, 2001) and the efforts involved within cognitive and structural modifiability attest to the increase in performance of those who change from impulsive to reflective cognisers (Carlson & Wiedl, 1992).

The purported success of psychology's measurement endeavours in years past which resulted in the perception of greater access to educational resources has played out in precisely the opposite manner for many minority groups (Sewell, 1987). It is these groups who stand to benefit more so from dynamic assessment interventions than their higher functioning counterparts within the dominant cultural group (Lidz, 1987b). *G*-based research accounts for intelligence but does not necessarily reveal the whole story of scholastic achievement (Nettelbeck, 1999) though the author tends to veer towards *g*-based performance. In other words, *g* severely underwrites global functioning no matter in what state of life an individual happens to find themselves. This does not negate the argument from polygenetic and phenotypical reactions to prevailing environments. Can phenotype be considered a norm of reaction or a response to unalterable genotype? The phrase "norm of reaction" was already coined as far back as 1909 by Woltereck and explains the changes undergone within an organism due to interaction of genes and environment ("genetic" does not refer to stagnation; Valencia & Suzuki, 2001). The greater the environmental resources the greater the phenotypical range of values (Ceci, Rosenblum, De Bruyn & Lee, 1997). Genetic inheritance works via additive and non-additive influences; the former being the result of the additive influence of genes which in turn influence the phenotypical response whereas non-additive influences are caused by differential influences of one or more genes at various locations (Brody, 1992, Grigorenko, 2004a) which are thus unique to each individual. It makes a mockery of genetic heritability research to be recast in eugenic or naïve consistency theory terms (where "heritability" in the past was construed as stable and unchanging; Sato, Namiki, Ando & Hatano, 2004) but acknowledgement of the overwhelmingly large role played by this form of interaction is necessary for an effective future programme or tradition on intelligence research. One can attempt to redress phenotypical responses through the use of programmes which seek to foster healthy "IQ-boosting" environments (also via micronutrient and general nutrient supplementation, Arija, Esparó, Fernández-Ballart, Murphy, Biarnés & Canals, 2006; Brody, 1992; Colom, Lluis-Font & Andrés-Pueyo, 2005; Eysenck & Schoenthaler, 1997) and can achieve movements up (or down) the IQ scale but one is always imprisoned within the norm of reaction. Moreover it is have been evidenced that nutrient supplementation really only benefits lower IQ performers resulting in decreased variance of this population and not really affecting the higher performers in the same manner (Colom, Lluis-Font & Andrés-Pueyo, 2005). The inevitable politicisation of these contentious issues results in a jaundiced view of the attempts to increase the unchangeable. Figure 26 below illustrates the certainty in the calculation regarding heritability and genetics and their subsequent influence on intelligence.

[168] It is this author's opinion, however unsubstantiated this claim may be, that non-cognitive factors may supersede intellectual powers in some instances. Determination, perseverance, will power and the like are more powerful in certain contexts than levels of intellectual functioning. Affect influences cognition and cognition influences affect (Messick, 1996). Of course this does not deflect attention away from what is genetically a predisposed likelihood of potential functioning.

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Figure 26 Heritability, intelligence and its calculations (Grigorenko, 2004a)

The not-so straightforward understanding of heritability and intelligence

- The relation between phenotype (P), genotype (G) and environment (E) can be expressed as
  - P = G + E ("in the genetic analysis of multiple phenotypic measures obtained on each individual, [a] basic structural model is invoked repeatedly for each phenotype, so that the system of linear structural equations defining a multivariate system [is characterised by this relation]" (Volger & Fulker, 1988, p.480)
- However, G and E must yet be divided into their respective components, namely,
  - Additive effects (A) from the combined differential effects of two alleles within and between genes; dominant effects (D) resulting from interaction between the alleles; epistatic effects (I) resulting from the interaction between different genes, environmental effects shared by all family members (S) and non-shared environmental effects (N). Thus, the general components of a phenotype can be expressed as
  - P = (A + D + I) + (S + N)
- However, the above expression does not take into account individual differences, or variance (V) within a population. The total variance is the phenotypic variance and is expressed as
  - $V = V_G + V_E = (V_A + V_D + V_I) + (V_S + V_N)$
- G and E components may be correlated leading to a value of VP twice its value in the above expression; twice the co-variance of (G)(E) or 2Cov(G)(E). Also there may well be interactions between G and E which is represented by V_GX_E
- The above expressions have decomposed via variance the heritability coefficient which is the indicator of the contribution of genes to the variation in a trait, namely, phenotypic variation
- Heritability narrowly construed is defined as V_A/V_P and heritability broadly construed is defined as V_G/V_P
- The above is, as all expressions in this thesis, purely abstract

Cautionary announcement …

- Behavioral ecology, behavioral genetics, sociobiology or however the area of interest is known is a population-based approach towards the quantified understandings of genetic/phenotypic interaction
- Intelligence research emanates from a very focused tradition of individual difference research
- **Hence population-based research ≠ individual difference research (the coefficient of heritability is not indicative of between population difference and moreover views population differences not individual differences)**
- Behavioural genetics research norms cannot be directly imported into individual difference norms
- Eugenics research did just this resulting in many unsavory activities
- Modern-day understandings take into account the above and are moving towards inclusive research (culture, bio-ecological models and the like) but
- This does not mean that behavioural ecology and individual difference research cannot work in tandem

And lest we forget …

- There are four mechanisms of genetic influence that have to be considered when discussing and debating the issue of heritability and intelligence, namely:
  - Mutation – random changes in both coding and non-coding genes
  - Random genetic drift – over time alleles change in frequency due to random sampling error which decreases as the population grows
  - Gene flow (genetic exchange) – combination of genetics from two different populations results in the offspring resembling both parent populations
  - Natural selection – resulting from the success of breeding within an environment, usually those that have adapted well (which is of course co-determined by the above three mechanisms)

(Sternberg, Grigorenko & Kidd, 2005)

Motivation, anxiety, metacognition,[169] persistence, impulsivity, temperament, confidence, personality factors (such as openness to experience for instance) (Gignac, 2005; Matthews, Zeidner & Roberts, 2005) and self-esteem (particularly pertinent to mediated learning experience and the learning experience in general) (d'Ydewalle, 1987; Elliott, Lauchlan & Stringer, 1996; Glaser, 1987; Hansen, 2003; Haywood, Tzuriel & Vaught, 1992; Kozulin, 1999; Meijer & Elshout, 2001; Paour & Cèbe, 2002; Resing, 1997; Samuels, 2000; Skuy, 2002; Zeidner, Matthews & Roberts, 2004) as well as higher order metacognition such as person appraisal, task demands and strategy; Howie, 2003) and the rather confusing aspect entitled cognitive or learning style which is partially culturally linked (Du Toit, 1990; Geldenhuis & Waterston, 1998; Lidz, 1987b; Owen, 1992; Richter, 1992), among other characteristics, can lead to under-estimates of individual abilities and are generally linked to intelligence in some form and are encompassed in a model referred to as task-related beliefs. It has been evidenced that it is not only capacity which allows for cognitive and educational growth but the concomitant and subsequent realignment of knowledge structures which necessitates at least rudimentary understandings of ones own metacognitive processes including memory, comprehension, learning, linguistics and communication (Benjafield, 1993; Biggs, 1985; Borkowski & Konarski, 1981; Das, Naglieri & Kirby, 1994; Feuerstein, 1972; Foster, 1986; Halford & Mccredden, 1998; Sharratt & Van den Heuvel, 1995; Van Ede, 1995). Metacomponents also feature heavily in Sternberg's triarchic theory of intelligence, an instance of an intelligence theory from an information processing perspective which seeks to link factors beyond conventional ideas on intelligence variables (Sternberg, 1997b) and a theory which has great potential in linking back up to dynamic assessment predicates. Expectations of failure or success can also greatly alter the outcome of test or intervention (Bethge, Carlson & Wiedl, 1982; Castelijns, Van Werkhoven & Stevens, 2002; Lategan, 1991; Pressley, Van Etten, Yokoi, Freebern & Van Meter, 1998; Resnick & Nelson-Le Gall, 2000; Stankov, 2004; Yussen, 1985). Feuerstein's theory of mediated learning experience specifically is viewed as an instrument of metacognition in that it offers both didactic and explanatory indices of individual behaviour (Birnbaum & Deutsch, 1996). Interestingly, Brand, Egan and Deary (1994) make a compelling argument for the influences of intelligence on personality and of course this raises a whole new research debate.[170] Non-intellective factors such as intrinsic motivation, locus of control and achievement motivation impact on the test situation, learning task and on test results (Boekaerts, 1988; Cordova & Lepper, 1996; Tzuriel, Samuels & Feuerstein, 1988).

Baron (1998), in his attempts to define intelligence, distinguishes between what he refers to as capacities and dispositions, the former tied to heritage and the latter being an aspect over which one has more control hence the need to work in synchrony. Metacognitive strategies come to the fore in certain dynamic assessment batteries where extensive training focuses in on this very aspect of intellectual functioning and not necessarily specific cognitive skills (Losardo & Notari-Syverson, 2001) although metacognition research has generally been confined to learning and memory research (Hertzog & Robinson, 2005). There is documented evidence for the neurological explanation of executive functioning of this sort which is yet another compelling reason to consider certain reductionist approaches towards the study of metacognition within dynamic assessment (Case, 1992; Davis & Anderson, 1999) as it has been evidenced that frontal lobe damage severely impedes metacognitive reserve (Hertzog & Robinson, 2005). Being aware and knowledgeable of ones own problem solving abilities, cognition, knowledge and control over the cognitive domain (Bruer, 1998) means that a challenge is more easily overcome if strategies utilised are better suited to the person's cognitive repertoire and includes encoding information, selecting the appropriate plans for action and identifying aspects that may impede progress (Davidson & Sternberg, 1998). This self-regulatory mechanism is particularly evident in expert approaches towards solving problems in certain domains when compared to the solving of problems by non-experts (Glaser & Bassok, 1989); which can tie back into dynamic assessment's teaching strategy where previously non-expert individuals become more knowledgeable about their own functioning as well as becoming aware of necessary task strategies. As Luria (1994) simply yet aptly points out, the young child does not posses the same memory capacity as an adult, mostly due to the fact that the child does not know how to use memory and has less to do with the fact that memory capacity exists (i.e. potential). These aspects, along with the ability to transfer these skills to other settings are considered paramount in dynamic assessment (Schlatter & Büchel, 2000), and as many interventions are conducted with children, metacognition takes on a leading role in how such knowledge of one's own skill develops; an area still being researched (Carr & Biddlecomb, 1998). The inability to self-regulate cognition within university entrants in South Africa is of particular concern as these students encounter difficulties with both cognitive and metacognitive backlogs (Craig, 1990). Older populations (over the age of 65) also make use

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[169] Metacognition has only really become of academic interest since the 1970's (with the coining of the term "metamemory" by Flavell in the 1970's; Campbell, 1993; Garner, 1988) but has already been explained in various cognitive models such as information processing, cognitive-structural, cognitive-behavioural and psychometric models or paradigms (Yussen, 1985). Its richest area of applicability is usually found within developmental psychology, (Nelson, 1998) hence its pertinence to dynamic assessment. However, as a notion it has a rich history predating modern times and stretching as far back as antiquity (Gleitman, 1985) and was clearly identified by Binet and Spearman as paramount ingredient in intelligence (Brown, Campione, Webber & McGilly, 1993). Metacognition has also been considered a separate approach within the "learning to learn" and "thinking about thinking" paradigm co-incident with the more dynamic assessment-like approaches which emphasise executive functioning of the person's thinking style (Bondy, 1987; Griffey & Claxton, 1997; Lloyd, 1995).

[170] Thinking that one is intelligent to a degree further inspires one to tackle tasks otherwise not approached resulting in a mixture of positive and negative experiences but possibly motivating one to succeed at ever higher levels of functioning. However, the flip side to this argument would be that one would have had to posses the knowledge of one's intelligence (thus being intelligent in the first place) in order to make this assumption. Yet another instance of blurred cause and effect. Their rationale and research results evidence that intelligence could well be viewed as a personality trait (Morgan, 1996), in which case the manner of assessing for intellect could differ quite substantially.

of self-regulated learning and as the population ages (at least in many Western countries) application of models which are currently focused on children will need to be increasingly shifted to older individuals about whom not much is known in terms of identification and assessment of learning difficulties (Dunlosky & Hertzog, 1998; Samuels, Lamb & Oberholtzer, 1992). Recall dynamic assessment's application within older populations. Aspects such as bravado, mischievousness, and obedience for instance correlate in both negative and positive ways with performance on various dynamically assessed tasks (Budoff, 1987a) and are heavily integrated into mediatory models of dynamic assessment (Jensen, 1992). Intelligence can be viewed attributively where judgments about ourselves and others are in fact what constitute intelligent behaviour (Goodnow, 1998) and such a view resonates with social aspects of cognition and intelligent functioning as identified by Vygotsky for instance. Intellectually disabled individuals, for instance, report low levels of emotional worth as opposed to their more able counterparts and general behavioural style is considered by some to be independent of learning ability (Budoff, 1987a). Academic achievement is so much more than a quantified score on a test (Frisby, 2001) and as one reads the literature, it seems that this concept is well understood and acknowledged by many educators, psychologists and practitioners; yet the wheels of testing grind away slowly without much of this progressive thought seeping through at a fast pace (Suzuki, Ponterotto & Meller, 2001).

However, movements within assessment such as dynamic assessment, curriculum-based assessment as well as portfolio-type assessments are making inroads within various educational settings where co-constructed knowledge and teaching is occurring in the classroom (at least this is the principle as identified on paper[171]) (Lidz, 2001; Suzuki, Ponterotto & Meller, 2001). Granted, time and money are overwhelmingly important, perhaps most important in the game of assessment, but ultimately it is the individual testee who pays the price of inadequate assessment.[172] Learning potential assessment approaches through their various mediatory styles are able to effectively cope with much of these adverse side-effects evidenced during mainstream intelligence assessment (Desoete, Roeyers, Buysse & De Clercq, 2002; Klauer, 2002; Meijer, 1993; Resing & Roth-Van der Werf, 2002; Ruijssenaars, Castelijns & Hamers, 1993).

2.9 Summary

Dynamic assessment is couched within intelligence research which is subsumed within the larger domain of psychology. In order to cast dynamic assessment in its proper light and in order to effect the meta-theoretical framework to be developed in chapter 3, it proved necessary to not only include a discussion on the fundamentals of this manner of assessment but also to plumb the depths regarding one very particular and very important chapter in its history and origin; that of its Soviet origins. Dynamic assessment is a perennially intuitive and appealing framework around which assessment issues have constantly interacted in some form or manner whether it was explicitly or tacitly admitted as such. A defining feature of this manner of assessment is its origins in chiefly non-Western countries where mainstream Western methods of assessment have either been banned or negatively looked upon due to the resulting appearance of low functioning individuals or due to reigning political ideology which via grand philosophising was not only considered deviant but dangerous. The need to somehow assess and assist (its key characteristics) low performing people necessitated an alternative approach which was both grounded in some sort of theoretical approach and amenable to wide-scale testing. Various themes emerged from a few core ideas that germinated during the early half of the twentieth century yielding parallel forms of assessment ideas that were both geographically and temporally separated yet shared a common theme stretching across these dimensions - a concern for fairness in assessment and a sustained effort to help those in need of assistance in a manner befitting more clinical-like modes of interaction. The process of engaging in matter to be learned and assessed is deemed a superior indicator of learning potential as opposed to static-based modes of assessment and is more in keeping with the valid construct of learning; a construct that static modes of assessment do not seek to engage with or measure in any way. Product-based approaches and their results manifest after material has been learned. In contrast, dynamic assessment is witness to the process that takes place during the learning phase. In allowing for situations which instigate change and thus direct change into the zone of next development, dynamic assessment assumes that such zones exist, although the width of such zones depends on the individual as well as what is being assessed. This brings into focus the need for domain-specific versus domain general assessments. The finer the skill and more complex the task the lower the efficacy of dynamic assessment's mediatory approach. This merely highlights one

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[171] The South African department of Education's initiative in the so-called "outcomes-based education" in which the student's learning process is increasingly emphasised as opposed to emphasis being placed on product-based assessment alone. Universities are still more attuned to the older style of assessment and when one deals with thousands of students, methods other than standardised testing are hardly much of an option. However, at tertiary education levels the intellectual levels attained are higher and are more easily reached than is the case with high school students for instance due to an increasingly restricted range of intellectual achievement. Hence, standardised testing may not pose as much of a problem. However, (and there is always an "however") the situation is not as straightforward as all that in South Africa for instance, where most universities have to implement some form of alternative assessment for those students who can be regarded as disadvantaged in terms of having had access to lower quality education. Time will eventually rectify this as more students attend school and facilities improve and so on. But until such a time is reached (unlikely to be reached in this author's generation) issues pertaining to alternative assessments still need to be addressed.

[172] Perhaps it is ultimately both the individual and society who pay the price. Is it perhaps not better to rectify a problem at the outset as opposed to waiting for someone to travel through the system and eventually land up being supported via other means many years later? This is a very difficult debate indeed: for whose responsibility is it? The individual or society at large?

of a number of paradoxes currently pervading the territory. One reason advocated as to why this may be so is the lack of construct validity evident in so many other areas within psychology and is not only problematic for intelligence research.

Coming to grips with dynamic assessment requires knowledge of its historical and philosophical roots. These tendrils are varied and only a brief look into Lev Vygotsky's Russia transpired in an effort to place one origin of this manner of testing. In essence, Vygotsky did not denounce mainstream testing and was forced to reckon with unpalatable dictatorial powers which coerced so many of his colleagues into other areas of research. Perhaps, in hindsight it can even be said that had it not been for these circumstances, the model from which much has grown might never have come to light. Attendant to this, though, was Vygotsky's seemingly own under-emphasised notion of the zone of proximal development which was not a fully fledged theory. It has since inspired many researchers in the West however to continue in similar vein.

The field of intelligence assessment is aligned in different ways along different fronts with each attendant alignment seeking evidentiary results in support of *a priori* assumptions. Many of the results offer alluring conclusions which augurs well for all the various alignments. Intelligence research has offered a galatial number of results with more than its fair share of contradictory theory and evidence for the past one hundred years. Some notions have remained the same whilst others have been seriously revised. The staggering amount of contradictory conclusions from these studies borders on the bewildering and the scenario is not much different for dynamic assessment. There are trends within mainstream assessment which seek to amalgamate newer models of intelligence which consider and place greater emphasis on non-cognitive variables, the role of phenotypic-genotypic interaction effects as well as more emphasis on process than product, although the extent to which this has seeped into most test batteries is not reflective of the gains made in acknowledging this. Likewise, dynamic assessment's tenets and founding fathers, although grounded in what has been described above, have not decried the use of mainstream intelligence testing nor have they advocated its disuse. Moreover, mainstream assessment methodology attests to greater reliability and validity whereas its dynamic assessment counterpart method cannot be said to have developed as robust a repertoire of techniques as has yet although there are new techniques propelling this area. There are areas of serious concern within dynamic assessment methods towards the understanding of change within testing and learning just as there are severe shortcomings within mainstream intelligence testing.

Dynamic assessment's concern with educability and trainability of individuals is underscored by the various assumptions regarding child development, specifically cognitive development. There is a traceable link between Vygotsky, Piaget and Feuerstein and their respective theories and models infiltrate modes of learning potential assessment with various differences and similarities. Perhaps one of the major issues within the field as it touches upon development theories is the degree to which humans are collaborators in their construction of the world as opposed to operating on the environment due to inherent timings which are genetically controlled. Currently this debate is not as strongly juxtaposed as it once was with most human development researchers agreeing that environmental press elicits or suppresses various developmental instances which are then set upon a course altered by the attendant environment. Piaget's theory was not a mechanistic treatise suggesting that the child develops only in strict accord with genetic developmental pacing but placed emphasis on the continuing interplay of both environment and genetic determination. Vygotsky's similar notion of environmental concern was more directed upon mediators in the environment which could helpfully provide enough "push" for the developing child so as to bring about growth which may not have occurred had such mediation never taken place. A continuous striving towards one's zone of proximal development results in growth and adaptation which need not cease at the end of childhood. This is reflected in the numerous areas of application within dynamic assessment.

Dynamic assessment is currently receiving much attention in the literature but this is not paralleled in practice where costs, timing and lack of training are often cited as the main reasons for the lack of inclusion of this manner of assessment, particularly in cash-strapped schools where personnel shortages and lack of funds militate against its use. There has been a consequent backswing of the pendulum in this regard with more tests being aligned along these very constraints which unfortunately results in a move further away from the initial goal of dynamic assessment. A positive feature of dynamic assessment methodology, however, is its continuing appeal to teachers and school psychologists alike who favour the approach or at least prefer to see both static and dynamic assessment methods being practised due to its all-inclusive nature and generally intuitive appeal.

The issue of placing dynamic assessment and intelligence within a meta-theoretical framework illustrates a three-fold problem; firstly, the field of intelligence, although overflowing in empirical studies and cumulative results over the past century has developed only partial theoretical models in keeping with results produced from such studies. The strain of competing models and theories brings into question the legitimacy of theoretical and empirical constructs (and attendant validity issues) within the domain of intelligence research (although this situation is not limited to this field alone). Secondly, dynamic assessment shares this concern regarding its various definitions and implementable strategies of which there are a number. It is partially aligned with intelligence research and shares a number of core assumptions but departs radically from a number of these core assumptions in other ways. The interwoveness of the two, commonly referred to as static and dynamic in turn has as a result that they usually operate in tandem but various movements within dynamic assessment history has pushed for the separation of the two in some quarters. One can consider dynamic assessment as leveraged upon intelligence or as developing in parallel

with it. Once again, this state of affairs is not limited to this particular area within psychology but characterises many sub-domains within psychology. Thirdly, meta-theory is seen by some as timely for certain areas of research and untimely for others; the placement of dynamic assessment within intelligence research within the broader framework of psychology will thus be greeted with both enthusiasm and dissent.

Successful merging of behavioural and biological correlates of intelligence and intelligence functioning is currently a trend within the field of intelligence research. This potentially fruitful avenue might well be worth pursuing in terms of dynamic assessment research. This does of course stand in stark contrast to the very reasons why dynamic assessment is not being implemented to the extent that it should be and would most likely not be feasible nor practical at this time in its course; but is something to consider for its future existence. This issue looks towards levels of description necessitated by different views on intelligence, development and growth in future endeavours to achieve potential in zones of proximal development. These developmental "leaps" are more often than not contextualised within the cognitive education domain, hence the emphasis on cognition within the intelligence discussion. Cognitive models, as with intelligence theories too are bound by reigning methodology of investigation. Depending on the nature of enquiry and tools utilised to do this, varying models come to the fore allowing for models of cognition to flower from different angles (computational, information processing and so on) which can serve and do serve as foundations for theories and models underlying dynamic assessment and intelligence. Some of these are now only of historical value whilst others are highlighted for their reality-endorsing views concerning human development (computational models which are better able to offer true-to-life renderings of brain functioning such as connectionist work). The section on dynamic assessment and intelligence draws to a close with a look at the increasingly dominant role that non-cognitive factors are starting to play within mainstream considerations of intelligence. Such concerns have been omnipresent within dynamic assessment since its inception as original notion, idea, thought, model and theory and in a manner of speaking, intelligence research has had to "catch up" to areas such as this. Dynamic assessment's emphasis on broader culture and contextualisation of individual functioning has allowed the model to move forward and develop in this terrain and can now offer something substantial by way of theory to the intelligence domain within which it is situated. Likewise, dynamic assessment can evolve into more robust scientific method by adapting methodology from intelligence research, specifically in areas such as behavioural genetics and biological renderings of intelligence constructs. Bridging hypothetical and empirical constructs however, remains a thorny issue for both dynamic assessment and intelligence research, but not insurmountable.

2.10 Conclusion

Chapter 2 introduced basic philosophical concepts of import to this study and aided in situating the various discussions. The treatise attempts to deal with the subject matter in an objective fashion but due to the nature of human and social science research the pinnacle of such objectivity is hardly likely to be achieved with the tools at researchers' disposal and although the toolkit within the scientific arsenal basically equips social science researchers to attempt rudimentary knowledge acquiring initiatives, there is a sense of the situations' hopelessness in this regard. However, this does not negate efforts at endeavours to strive for as much scientific legitimacy as possible which is precisely the aim of this treatise as far as it's underlying scientific enquiry is concerned. Couched within the above is a veiled allusion to the author's own preoccupation within the knowledge acquisition enterprise. These opinions, although supported and argued for via cited works remain at the core of this study and permeate the narrative throughout. No serious scholarly opinion can enter into the arena of informed debate without the requisite foundations being fairly entrenched for such deliberations which is why the section leading up to dynamic assessment within intelligence was necessitated. The author entreated the reader to enter into the foregoing discussion with certain assumptions in mind and included a reference to the time and place in which the work is written, the philosophical leanings within the study as well as further discussion into various ontological and epistemological matters. Brief attention was paid to what can be considered seven crucial areas within intelligence research; the mind-body problem; consciousness, *g*-dominated vs. multiple intelligence dominated leanings towards the understanding of intelligence; emergence (irreducibility) vs. reductionism; realist vs. relativist approaches towards research; nature-nurture and static-dynamic conceptions towards the assessment of intelligence and potential. The emphasis within these discussions centred on argumentation on varying points of view. An attempt at well-rounded and fairly debated understandings of these issues was presented. The chapter focused more on introducing dynamic assessment both from a fundamentalist and historical point of view with emphasis on Vygotsky's Soviet origins as to how this played forth in his thinking at a time in what can only be described as Russia's turbulent past. Current awareness of dynamic assessment was perused as this informs the continuing debate surrounding its eventual use or disuse within intelligence assessment research. Lastly, intelligence as domain within psychology was discussed with particular concern for dynamic assessment's place within the broader field. Now that the foundations have been cemented by way of introducing "dynamic assessment and intelligence"place is made for the construction of a meta-theoretical framework to house the above-mentioned concerns.