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# Cognitive Abilities of ‘Street Children’: A systematic Review

Graham PLUCK

## Abstract

Although relatively rare in industrialised and developed countries, the phenomenon of young people spending much of their time in urban environments in the context of extreme poverty is common in the cities of the developing world. Interventions are generally focused on bringing the children into education systems. However, the children have often been exposed to a range of factors likely to impair cognitive development, such as trauma and substance abuse, potentially limiting the efficacy of education programmes. A systematic review was performed of studies reporting cognitive function data of street children in developing countries. Only seven studies were found, which reported on 215 individuals. A review of the studies revealed a pattern of below normal general intellectual function and neuropsychological impairments. In those studies where measures of general intellectual functioning were reported, e.g. IQ, comparisons of effect sizes were made. This revealed that cognitive impairment appeared to be relatively minor in samples from Indonesia and South Africa but somewhat larger in samples from Ethiopia and Colombia. The results suggest cross-cultural variation in the effects of street living on cognitive development. However, in general, there is a pattern of lower than normal cognitive performance which is comparable to that observed in studies of homeless children in the USA.

## Key Words

street children, homelessness, IQ, intellectual function, cognitive development

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## 1. Introduction

A political slogan used on signs in Cuba reads ‘200 millones de niños en el mundo duermen hoy en las calles, ninguno es cubano’, the English translation is ‘Today 200 million children worldwide

sleep in the streets, not one of them is Cuban’. Whether or not there are no homeless children in Cuba is debatable, as is the figure of 200 million for the rest of the world. Two hundred million may or not be an accurate estimate; the truth is that the real extent of homeless children living in the urban centres of developing countries is largely unknown. Although such large figures are often presented both in political and academic literature on the subject, one authority has recently warned against the quoting of absolute numbers, simply because they are all mere guesswork (Thomas de Benitez 2011 : 5).

In contrast to the patriarchal Cuban perspective which is clearly based on its communist socio-political model, in other Latin American countries, street children are often vilified by the gen-

eral public, the media and governmental agencies. For example, in Brazilian cities street children are commonplace and receive very little protection from the state. In fact, it is believed that politically motivated vigilantes and rogue police units often murder street children at the request of local businesses (Inciardi & Surratt 1998: 11).

While there is a large corpus of research on the lives of street children from diverse social perspectives, particularly ethnographic (e.g. Aptekar 1991) very little research has looked at psychological abilities. This is an odd omission considering that much of the concern regarding street children is their apparent absence from school. A related line of investigation, particularly in the NGO sector, is on remediation and programmes to bring street children into mainstream education and society (e.g. Lusk 1989). In addition, patterns of substance misuse by street children are often the subject of interest from medical research perspectives (e.g. Vega & Gutierrez 1998). However, the success of reintegration into education systems will to some extent be decided by the cognitive development of the children. This is likely to be abnormal, particularly in those with significant substance abuse histories. Substance misuse is indeed common among street involved youth, particularly 'glue sniffing'; however this is only one of many features of their lives which could negatively impact on neurocognitive development. Other features include malnutrition (e.g. Patriasih, Widiaty, Dewi, & Sukandar 2010), exposure to toxic pollution (e.g. Samaniego & Ben&iacute;tez-Leite 2002) and violence (e.g. Márquez 1999).

Despite this, there is very little information available about the developmental effects of the extreme privation associated with street living of children in developing countries. To a large ex-

tent, this is a consequence of the bias in academic research of focusing on the issues that concern rich industrialised countries. For example, several academic studies have been made of the consequences of homelessness on cognitive function in adults. Studies in the USA (e.g. Solliday-McRoy, Campbell, Melchert, Young, & Cisler 2004) and in the UK (e.g. Pluck, Lee, David, Spence, & Parks 2012) have shown a tendency for general intellectual function, such as that measured by IQ tests, to be lower in samples of homeless adults. In fact, homeless adult samples in these industrialised countries appear to score about one standard deviation below the estimated mean of the general population of the country. This probably reflects the range of negative influences on neurocognitive function that are associated with homelessness in those countries, e.g. high rates of childhood trauma, mental illness and substance abuse (Pluck, et al. 2011).

Similar effects are found in samples of homeless children and adolescents in industrialised countries. Several studies in the USA have reported that cognitive functions are lower in homeless children, when compared to general population norms. For example one study of African-American children in homeless families in the USA reported that on an IQ test they scored at the 34<sup>th</sup> percentile (Masten, et al. 1997). This is equivalent to an IQ of about 86. The mean score for the USA population on the test was set at 100 with a standard deviation of 15. Therefore it can be seen that the homeless children scored nearly one standard deviation below the mean.

It has been noted in recent years that there has been a consistent increase in intelligence test performance globally. In fact population IQ scores have been increasing by about 3 points per decade, a phenomenon known as the 'Flynn effect' (Neisser 1997). Effectively, this means that IQ

tests tend to overestimate as they age. The Masten et al study of homeless children, described above, was published 11 years after the IQ test that was employed. If we correct for the Flynn effect by adding 0.3 IQ points to the average for each year of difference, the homeless children scored even further from the estimated population norm. This particular adjustment makes only a small difference; nevertheless, it highlights the need to correct for the Flynn effect when comparing IQ scores from different studies, as this systematic review attempts to do.

A further complication is that average IQ scores not only change over time, but also have considerable geographical variation. Essentially, the normal population mean varies by country, though some authors seem not to have accounted for this and have applied IQ tests that were normed in the USA, to their home country. This will tend to give misleading information about how samples of IQ scores relate to the 'general population'. In part this is understandable, IQ test development is complicated and costly, so fully normed tests are not available for most countries. For example, studies in Indonesia sometimes use tests developed in the USA, however what should be considered an average score will differ between the two countries. A set of estimations for average IQ score differences between countries has been published (Lynn & Vanhanen 2002). This estimates that the difference between Indonesia and the USA is about 9 IQ points. Although these IQ differences are somewhat debatable and imprecise, correcting with them is likely to produce more accurate results than not correcting at all.

The cognitive studies described above on homeless children and adults in the USA and the UK are informative in that they give an indication of the psychological correlates of socioeconomic deprivation. Nevertheless, the context of

the street child in developing countries is somewhat different to that of the homeless person in industrialised countries. Although some street children may sleep and live in urban spaces not designed for habitation, the fact is that many street children, perhaps most, are not strictly homeless. They may have families or care centres that they return to in the evenings. Some may be beggars or spend their time on a range of other activities, including involvement with petty crime or drug use. A significant proportion may be there to work, for example selling candies or newspapers in bars and to cars stopped in traffic. It is important to understand that the concept of 'street child' is usually taken to mean children spending much of their time in city streets generally unsupervised and unprotected, and in the context of profound deprivation and inequality (Rizzini & Lusk 1995 : 391). Needless to say, they are usually not involved with mainstream education systems, a fact which in itself is likely to impact on their cognitive development in comparison with less 'at risk' children who are actively engaged with educational services. Despite this, there are only a handful of isolated studies available in the academic literature of the cognitive abilities of street children, and no known academic reviews.

The current study aims to examine all of the available English language published data on cognitive abilities associated with street children in developing countries. It was anticipated that a wide range of approaches and forms of cognitive assessment would have been applied. Where this is the case, these have been described on a study by study basis. Where measures of general intellectual function, e.g. IQ, have been reported, statistics were recorded for cross-study comparison, and average scores have been adjusted for country by reference to published national IQ differ-

ences (Lynn & Vanhanen 2002) and the Flynn effect as necessary. As it was expected that very few publications would be located, to maximise the potential of the review, any studies of any cognitive measures in any children who would be considered as street children were sought.

## 2. Systematic review

### Method

A systematic review of the existing data on cognitive function in street children was performed. The broad definition used was one published recently in a review of academic research on the topic: "*Street children are recognised to be young people who experience a combination of multiple deprivations and 'street-connectedness'*" (Thomas de Benitez 2011: viii). Clearly, this will include a variety of children and adolescents in very different contexts. For example, children who spend much of their time in the urban environment working as street vendors could be included, as could members of street gangs or beggars, providing there is also evidence of significant socioeconomic deprivation.

Nevertheless, to perform the systematic review it was necessary to set other parameters. Studies were only included if the mean age of the sample of children was between 5 and 16 years. Studies were only included that reported direct measures of some cognitive function (e.g. intelligence, memory, attention, perception). Therefore indirect measures, such as appraisals by care staff or school performance records, were not considered valid. In addition, studies that were published only as conference abstracts were not included. As we wished to concentrate on cognitive function, studies that primarily reported on criminal or forensic topics, or that were focused on medical illnesses of street children were ex-

cluded. As identified in the introduction, there is a dearth of research on this issue in developing countries, for this reason, studies on samples from rich industrialised countries were excluded, and samples were only included from countries included in the International Monetary Fund list of emerging and developing economies (International Monetary Fund 2012: 194–197). In practice this was very simple, all of the non-developing country publications located in the search were of homeless children in the USA, bar one in pre-unified West Germany. In effect, all of the others were considered for inclusion.

The first search of the literature was performed in English with the Thomson Reuters Web of Knowledge online database. The search term used was designed to be overly inclusive:

Topic = (intelligence or IQ or cognitive or cognition) AND Topic = (child or youth or adolescent or childhood or teenage) AND Topic = (homeless or homelessness or "street child" or "street children" or street)

This produced 300 results in Web of Science and all were examined for possible inclusion. Following this, additional searches were performed in English with the Google Scholar and Google Books online search engines, using combinations of the same words as used with Web of Knowledge. Furthermore, existing review articles on child homelessness and street children were reviewed and potential sources in the bibliographies accessed. After removing duplicates, only 18 publications were identified that contained cognitive function data on probable street child samples. Of these, on closer examination three were excluded because the children involved did not fit the definition of 'street child'. A further four were excluded because they re-reported

data published previously and that had already been selected for inclusion in this systematic review. Two sources, one book published in Colombia and one medical journal article published in Mexico were not retrievable despite several attempts. Although not formally included, as they could not be read by the current author, the small amount of information available on these two sources is discussed below. One book published in India on the psychology of street children was retrievable. However, despite reporting information on IQ scores of street children, there was insufficient information provided on the background of the sample and methods (Agrawal 2003).

Consequently, seven publications were included in this review. Taken together they reported data on 215 different street children. Only one study described street children in an Asian country (Indonesia), three studies reported on street children in Africa (South Africa and Ethiopia) and three studies on street children in Latin America (Colombia and Brazil). These are summarised in Table 1 and discussed in detail below. Wherever possible, if data were included on tests of general intellectual function (e.g. IQ) in which population norms are known, then means and standard deviations were extracted. In other cases, if data on normal control samples were included, then means and standard deviations were recorded. This was done so that, where possible, comparisons of effect sizes across studies could be made.

### 3. Findings of the systematic review

A primarily ethnographic study of street children in Colombia contains some IQ data relevant to the current review. The author, Lewis Aptekar, published the data in several articles, however, in each it appears to be the same data set, and the current analysis is based on the first de-

scription he published (Aptekar 1988). His sample was 56 street children, aged 7 to 16, who were attending a 'walk-in store front program' in the city of Cali. To measure IQ he used Kohs Blocks design (Kohs 1920) which is an accepted measure of IQ, although it has been rarely used in academic research since its inception in the 1920 s. Needless to say, the normative data that this test is based upon are considerably out of date. From examination of the data given in the article, the standardisation population mean appears to be 100 with a standard deviation of 15 (Aptekar 1988: 230). To adjust for location it was necessary to subtract 9 IQ points, and for the Flynn effect to add 19.5 IQ points. It is therefore estimated that the normal population mean for Colombia in 1988, the year Aptekar's paper was published, would be 110.5. The sample of street children scored an average score of 88.4, they therefore scored about 22.1 IQ points below the estimated population mean.

Although not containing any information about intellectual function in general, a study of cognitive abilities of street children in Brazil is also of interest. This study focused on auditory processing and included 27 children who lived on the streets of Sao Paulo and 26 children of the same age who were not homeless (Borges-Murphy, Pontes, Stivanin, Picoli, & Schochat 2012). The street children performed worse than the controls on almost all measures, implying significant auditory-cognitive processing impairments. Nevertheless, a neurophysiological measure of brainstem auditory evoked potentials failed to reveal any underlying neurological reasons for the poor test performance.

In contrast to the study of auditory processing which found reduced function in the street children compared to controls, a different study of street involving youths in Brazil has reported

**Table 1** : Details of studies included in the systematic review of cognitive function of street children

Reference	Sample	Mean age	City and Country	Comparison group	Tests of interest
Apteker, 1988	56 street children	11.6 (range = 7-16)	Cali, Colombia	Normative data	Kohs Block Design Test
Borges-Murphy, 2012	27 children living in the city streets	Children : 8.9 (SD = 1.3) Adolescents : 13.2 (SD = 1.6)	São Paulo, Brazil	26 children of the same age	Tests of auditory cognitive function and an electrophysiological measure of brain stem function
Saxe, 1988	23 street child vendors	10.8 (SD = 1.0)	Recife, Brazil	Two groups of non-vendors, 20 urban and 17 rural	Custom tests of mathematical ability
Hartini et al, 2001	42 street children	11.5 (range = 10-12)	Ngagel and Banyu Urip, Indonesia	Normative data	Cattell Culture Fair Test ii
Jansen et al, 1992	44 street children (half were glue sniffers)	14.1 (SD = 1.46)	Johannesburg, South Africa	22 domiciled children	Various neuropsychological tools, of particular interest the Category Test of the Halstead-Reitan Battery
Jansen et al, 1990	22 glue sniffer street children	Not given, but see Jansen et al, 1992	Johannesburg, South Africa	No comparison data	Various neuropsychological tests and neurological and neurophysiologic examination
Minaye, 2003	23 child beggars	5.6	Addis Ababa, Ethiopia	30 children from a local kindergarten	Custom made tests of intellectual function

performance better than control levels. This study compared the mathematical abilities of a group of child street vendors with a control group of non-vendors from nearby state schools and a second control group of rural living children (Saxe 1988). The street vendors would buy products at warehouses, typically candies, and then sell them individually on the streets or on buses. Not only did they need to use mathematics in individual transactions, but they had to calculate strategically when bulk purchasing the product that they would sell to the public. Despite having very little formal education, the children who were street vendors had comparable levels of mathematical ability to the school attending

children. In fact, on several assessments their performance was significantly better. The authors conclude that the life experiences of the children had driven their cognitive development for mathematical processing.

Two other reports should be mentioned at this point as they also have bearing on IQ scores of Latin American street children. One is a study in which IQ tests were applied to a large sample of 263 street children. It reported that about 26% of the sample scored so low that they would be considered mentally retarded, and only 22% were said to be at levels of average or above intelligence (Cortez 1969). Unfortunately this book was not retrievable by the current author to extract

further details, however Apteker, who cites it and gives the percentages described above, notes that Cortez gives no information about which tests were used or the procedure applied (Apteker 1989: 432). It is therefore likely to be of limited value.

A second study that should also be mentioned was also irretrievable by the current author, due to its publication in a parochial medical journal and incomplete reference information being available. This is a study of the IQ of former Mexican street children who had been chronic solvent abusers (Ortiz, Osornio, & Zavala 1995). However, a review article published in Spanish on drug use by street children in Mexico describes the Ortiz et al study (Gutierrez & Vega 2003: 30). The available review describes the children as having various neuropsychological impairments including to memory, concentration, abstract reasoning and concept formation. The review also describes a test of intelligence being used with the children, their average IQ on the 'WAIS' apparently being 77. However, assuming by WAIS they mean the Wechsler Adult Intelligence Scale, it is unclear why a test designed for adults would have been used with children. This publication and that by Cortez mentioned above were not sighted by the current author. They will therefore not contribute to further analyses or conclusions reached in this review. However, as there is so little information available on this topic, what brief descriptions that were available have been included for the sake of completeness, and for other readers who may wish to pursue the matter.

A group of researchers has published two overlapping studies of black 'glue-sniffers', all boys, involved with an education program for street children in South Africa (Jansen, Richter, & Griesel 1992; Jansen, Richter, Griesel, & Joubert 1990) In the first report, which did not include a

control group, scores on a range of neuropsychological measures were reported with reference to standard clinical definitions of impairment. From this perspective, the boys appeared to have multiple cognitive problems. They appeared to have visuo-spatial deficits, language processing problems, poor problem solving, motor coordination problems and attention, concentration and memory difficulties. In fact, 19 of the 22 boys were said to have multiple neuropsychological deficits. Furthermore, this investigation included neurological examinations and neurophysiological tests. Two of the boys showed abnormal neurological signs, indicative of brain damage (cerebellar). On electroencephalographic recordings, only 4 of the 22 boys had normal readings. This seems to suggest that glue sniffing has had a serious neurocognitive impact on the children.

However, the second study of the same 22 street children included a control sample of street children who did not have histories of glue-sniffing (Jansen, et al. 1992). They again reported a range of neuropsychological and IQ measures. Interestingly, when compared to the street children who were not glue sniffers, there were no significant differences. This seems to suggest that although the glue-sniffing street children had unusually low performance on cognitive tests, their drug abuse was not a significant cause of the problem.

If we accept that low function in this sample is simply a correlate of being a street child, then it would be of interest to know how well the street children would have performed in comparison with non-street involved children. Unfortunately, the authors did not report any conversions to normalised scores, only raw scores which make it impossible to work out how the street children did in comparison with non-street children. How-



ever, for one test, the Category test of the Halstead-Reitan Battery, they also provide the mean and standard deviation of a sample of black South African youths (Jansen, et al. 1992: 33). That particular test is closely correlated with IQ and can provide a measure of general intellectual functioning. As there was no difference between the glue sniffing and non-glue sniffing street children, their scores on the Category test were combined to produce an average raw score of 113.1 (SD = 23.7) which is somewhat lower than the reported black youth sample of 121.7 (SD = 18.1). However, the authors reported that a three way analysis of variance comparing performance of the three groups; street children with or without glue sniffing and the domiciled control, revealed the differences were not statistically significant.

A third report included in this review was of street children in Africa, though this time from Ethiopia. The report by Minaye is a postgraduate thesis published on the internet. Although these would not usually be included in systematic reviews, as there are so few reports available it has been included as it still sheds some light on the issue. However, as it is not from a peer reviewed source, conclusions should be drawn from it cautiously. The thesis contains cognitive function data on a sample of 23 children working as beggars in Addis Ababa and a control sample of 30 children from a nearby kindergarten. They did not use conventional IQ or neuropsychological tests, instead they designed their own as they noted that there were no validly normed tests available for Ethiopia (Minaye 2003: 48).

The test they used appears to resemble IQ tests, involving some general knowledge items and vocabulary description tasks. Importantly, most of the subtests inter-correlated, suggesting that they measure the same basic phenomenon,

as tests of general intellectual function should. The author provides the raw data and so it was possible to sum the scores of the tests (excluding the one that did not inter-correlate) to derive a basic measure of intellectual functioning. The mean score of the street children was 117.5 (SD = 15.2) and for the control sample it was 144.4 (SD = 9.4). As the full data sets were available for both the street children and the control it was possible to compare them with inferential statistics. A between groups t-test revealed that the difference was statistically significant,  $t_{(51)} 7.93, p < .001$

Although the review process was conducted on English language databases, one report written in Indonesian was found in the search. This was included as it fulfilled the inclusion criteria. The report included IQ scores of 42 Indonesian street children aged 10–12, in Ngagel and Banyu Urip (Hartini, Subekti, & Nur Ainy 2001). They used the Cattell Culture Fair Test ii (Cattell 1973), this is an IQ test with a normative mean set to 100 with a SD of 24. The authors provide individual IQ scores in the paper, these were used to calculate a mean of 93.5 (SD = 17.3). However, the IQ test was normed in the USA in 1972. Accordingly, to convert the mean to an Indonesian estimated mean in 2001, the score was reduced by 9 points to control for the difference between the USA and Indonesia and increased by 8.4 points to correct for the Flynn effect. The corresponding estimated population mean was therefore 99.4, the street children scored on average only 5.9 IQ points below this. As the raw data were available it was possible to perform further inferential statistics on the statistical significance of the result. A one-sample t-test revealed that the street children scored significantly below the estimated population mean,  $t_{(41)} 2.20, p = .033$ .

Although the study by Hartini et al was the only one included from Asia, as mentioned above,

another study was uncovered in the search which appears to report on IQ scores of street children in India (Agrawal 2003 : 134–136). In the study described, a group of street children were compared with school children for performance on Raven's Coloured Progressive Matrices, an established IQ assessment. The author of the book reports that the school children scored above average on this test and the street children scored at an average level. However, the method for determining 'above average' and 'average' is not clearly described; in fact it appears to be very idiosyncratic. Furthermore, insufficient information was provided on the sample for us to be sure that they matched our definition of 'street children'. In fact it is not clear whether the sample is even from India or not. The results are therefore not formally included in this review, though it is referenced for the sake of completeness.

#### 4. Synthesis

Although the studies described above have tended to use a variety of methods among diverse samples, it is possible to draw some of them together statistically for comparison. The studies by Aptekar in Colombia, by Jansen et al in South Africa, by Minaye in Ethiopia and by Hartini et al in Indonesia all presented data on general intellectual function of street children in comparison with a control or normative sample. Therefore it is possible to calculate effect sizes across these studies and compare them directly. To do this Cohen's  $d$  (Cohen 1992) was calculated for the difference between the street child sample and the control or normative sample. In practice this is simply a matter of dividing the difference between the two means by the standard deviation of the control or normative mean. The benefit is that effects observed using different assessment methods can be directly compared.

The results of the estimations of effect size are shown in Figure 1. Also included in the figure, for comparison, are data from the study by Masten et al (1997) of homeless children in the USA, which was considered in the introduction. Although effect sizes do not have polarity, plus and minus information has been maintained in Figure 1 to show the direction of the effect. As in each case the street child/homeless groups mean was subtracted from the control sample mean and divided by the control sample standard deviation, an effect size that is less than zero therefore indicates that the street/homeless children performed below the level of the normal comparison group. In fact this was observed in all of the five studies. The effect sizes range between .25 for the study of Indonesian street children by Hartini et al (2001) to 2.87 for the child study of street beggars in Ethiopia by Minaye (2003).

#### 5. Discussion

The comparison of effect sizes revealed that in all cases where this was possible, the street children scored below the level of their control or normative samples. This appears to imply a consistent result of low cognitive function in the street involved children. The effect sizes ranged from a small difference (.25) in the study of Hartini et al of Indonesian street children, to the very large difference (2.87) reported by Minaye in their sample of street begging children in Ethiopia. However, it should be noted that in the Jansen et al study in South Africa, the difference was not statistically significant.

The study by Minaye in Ethiopia reported the most clear cut difference, in that study between a group of street involved children and a kindergarten based control sample. The children who had been beggars around churches and mosques in Addis Ababa scored significantly below the

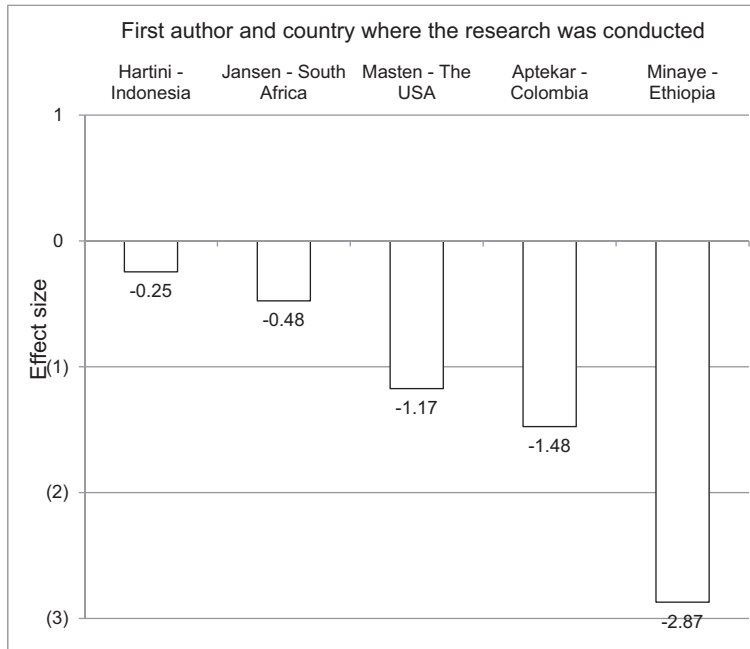


Figure 1 : Effect sizes (Cohen's *d*) for the differences in intellectual functioning scores between the street children groups and their respective comparison data

control level, with an effect size of 2.87, which effectively means they were nearly three standard deviations below 'normal'. However, there are several caveats that reduce the reliability of this result. The children were very young, only just within the study inclusion criteria of being on average at least 5 years of age. At such young ages developmental delays are likely to have large effects due to rapid cognitive development. So it may simply be that the street children were somewhat delayed in their development. More importantly, these data were taken from a post-graduate dissertation which had not been published in a peer reviewed periodical, as the other data sets had. Furthermore, the tests used were custom made and not formally validated as psychometric tools. These issues are particularly pertinent considering the very large effect size, much higher than in any of the other studies. For these reasons, the result from this study will be

considered with particular caution.

Nevertheless, the range of effect sizes found in this systematic review for the differences between street children and appropriate comparisons samples is between .25 and 2.87. At the lower end of the range, the effect sizes are not particularly large considering the privation suffered by the children and their isolation from mainstream education. In fact, qualitative categories are available for effect sizes (Cohen 1992: 157). The effect sizes in the Hartini study in Indonesia would be considered negligible (i.e.  $<.2$ ) and in the Jansen et al study in South Africa it would be considered 'small' (i.e. between  $.2$  and  $.5$ ). The effect sizes in the Aptekar study in Colombia and the Minaye study in Ethiopia would be considered 'large' (i.e.  $>.8$ ). A study of homeless children in the USA was included in Figure 1 for comparison. This also had a 'large' (i.e.  $>.8$ ) effect size of 1.17. The homeless USA children scored on aver-

age more than one standard deviation below the national norm. This large effect size is fairly standard for studies of homeless children in the USA, which consistently report differences of about that magnitude.

It can therefore be tentatively concluded, that street children in developing countries tend to show a similar pattern of reduced intellectual function to that observed in homeless children in the USA. Though there appears to be a great deal of variation, with the effects being negligible or qualitatively 'small' in the Indonesian and South African samples respectively, but qualitatively 'large' in the Colombian and Ethiopian samples. Nevertheless, there is some consistency in that all of the included studies showed relatively reduced levels of intellectual function in the street children. Conclusions from this systematic review cannot be any more precise due to the low number of studies available for review and analysis.

The discussion above focused on general intellectual function, in essence that which is measured by IQ tests. There are likely to be more focal differences in specific domains of cognitive functioning, and these are even more likely to vary between different cultures and different groups of children. For example the study of auditory cognitive processes in Sao Paulo, Brazil, revealed a wide range of impairments in its sample of homeless street children.

Substance abuse is likely to be an important contributor, as this has been reported to occur in very high levels in many groups of street involved children, in particular glue sniffing seems to be linked to the severe deprivation of street life (e.g. Dominguez, Romero, & Paul 2000; Gutierrez & Vega 2003; Huang, Barreda, Mendoza, Guzman, & Gilbert 2004) Glue sniffing is a particularly toxic practice with significant poten-

tial to cause permanent brain damage. Indeed, one of the studies in South Africa included in this review reported that most of the street children who were glue sniffers had abnormal neurological signs implying some level of brain damage (Jansen, et al. 1990). Interestingly, although the glue sniffers in that study appeared to have a range of accompanying neuropsychological impairments, when the same children were compared to street-children who had not been glue-sniffers there were no differences in neuropsychological abilities (Jansen, et al. 1990).

A further source of differences in cognitive functions of street children and non-street involved children is likely to be driven by access to mainstream education. This would imply that some abilities would not be developed due to the street children being deprived of the educational opportunities that many other children have. However, it should also be noted that as we are talking of developing countries, school attendance is often not the norm anyway. Furthermore, many street children are actively working in the urban environment which may imbue them with real world skills, knowledge and cognitive development. Indeed, this is what was found by Saxe et al in his study of Brazilian street child vendors. Their mathematical abilities were as good as those of children attending school; in fact in some forms of calculation, the street vendors were significantly better (Saxe 1988).

The study by Saxe is not the only study that has used Brazilian street child vendors in academic studies of mathematics ability. However, other studies were not included in the systematic review for various reasons. In one it was not clear that the participants matched the study inclusion criteria of being street children by the given definition, rather than simply helping on the trade stall of their parents (Carragher, Carragher, & Schli-

emann 1985). In another, the participants were street children by the definition, but the study focus was really on a specific type of mathematical skill development, multiplicative commutativity, rather than on cognitive functioning as it would usually be understood (Schliemann, Araujo, Cas-sundé, Macedo, & Nicéas 1998).

Overall conclusions are difficult to reach as there are so few studies available on the cognitive abilities of street children in developing countries. More research on this topic would be useful considering the implications for services with street children, particularly those aimed at bringing them into education systems. Nevertheless, the available data suggest that some reduction in general intellectual functioning and some focal cognitive impairments tend to be associated with street connectedness of young people in the context of multiple deprivations in developing countries. However, there appears to be large degree of variation between the studies; in some of the samples the effect on cognitive functions appeared to be quite minor, in others, much more pronounced. This probably reflects the diverse social and economic conditions in the different countries and how these contribute to and maintain children in situations of severe urban poverty.

## 6. References

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