Is Adaptive Behaviour too Normal to be Normally Distributed?

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ABSTRACT

Purpose: This study attempts to ascertain if adaptive behaviour complies with the characteristics of a normal distribution.

Method: Adaptive behaviour data collected from two large state samples of 2900 were reviewed to determine the shape of their distributions. A smaller convenience sample of 37 adults without intellectual disability was similarly reviewed.

Results: Findings suggest that the shape of the distribution of adaptive behaviour increasingly deviates from normal as cognitive abilities increase.

Conclusions/Implications: It does not appear that adaptive behaviour is normally distributed. This will impact the diagnosis of intellectual disability because while IQ scores two standard deviations below the mean reliably cut off about 2% of the population, a similar cut-off cannot be assumed for adaptive behaviour.

Keywords: Adaptive behaviour; normal distribution

INTRODUCTION

The definition of intellectual disability is based on the conjoint assessment of intelligence and adaptive behaviour (Schalock et al, 2010).In order to be classified as having an intellectual disability, a person must have significant deficits in both areas, with the onset of these deficits occurring prior to age 18. Significant deficits are defined in comparison with the general population, such that a significant deficit is approximately two or more standard deviations below the norm of the general population.

This sort of quasi-psychometric definition is quite workable for the assessment of intelligence. Intelligence is widely believed to follow a roughly normal distribution. An IQ score of two standard deviations below the mean reliably

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cuts off the bottom 2.28% of the population, based on the known properties of the normal distribution. In a sense, the operational definition of a significant deficit in intelligence is a score that is approximately in the bottom 2% of the general population.

Do the mathematical underpinnings of adaptive behaviour support such an interpretation? It is not clear that the adaptive behaviour of the general adult population follows a normal distribution (Tasse et al,2012).Most members of the general population are able to score a perfect or near perfect score on any test of adaptive behaviour. At the common level, most of us know people who are exceptionally intelligent. Does anyone know a really super toileter? Are there any genius-level hand-washers out there? Adaptive behaviour reflects skills demonstrated by the overwhelming majority of the general public. It is a series of largely developmental tasks which are completely accomplished by the time most persons enter adulthood. It follows then, that the likely shape of the distribution of adaptive behaviour would seem to approximate only the left half of the normal distribution, sometimes called a triangular distribution. Most people achieve full competence in adaptive behaviour by adulthood, and there really is no provision for super competence in adaptive behaviour. Therefore, there is little reason to anticipate that adaptive behaviour is normally distributed or that the properties of the normal distribution should pertain to adaptive behaviour.

There are implications of the non-normalcy of adaptive behaviour. If the distribution of adaptive behaviour is not normal, then the percentile rankings derived from the properties of the normal curve do not pertain. Two standard deviations below the mean of the general population on adaptive behaviour might not cut off the bottom 2.28%. In fact, if the properties of the normal distribution cannot be applied to adaptive behaviour, it is really not known what percentage of the population is cut off by two standard deviations below the mean. One may recall that McDevitt et al (1977) expressed similar concerns about the marked skew of the 13 Part II 'maladaptive behaviour' domains on the AAMR Adaptive Behaviour Scale. They noted that in some 'maladaptive behaviour' domains, a person with no evidence of 'maladaptive behaviour' might earn a ranking in the 70th to 80th percentile. Without directly linking their concerns to the issue of normalcy, McDevitt et al (1977) clearly raised concerns regarding the interpretation of non-normal data.

Distributions closer to normal can be achieved when one limits the sample being studied to persons who have disabilities. Several of the available adaptive

behaviour scales offer norm groups comprised of persons with intellectual disability. The AAMD Adaptive Behaviour Scale (Nihira et al, 1974), for example, offers a norm group comprised of persons living in state institutions at that time. The revision by Nihira et al (1993) also employed a norm group comprised of individuals with "developmental disabilities" living in a variety of sites. The problem is that even if the resultant distributions are normal, how can a condition such as intellectual disability be diagnosed by comparing an individual only with individuals who have that disability? The Vineland Adaptive Behaviour Scale (Sparrow et al, 2005) significantly improved on this issue, employing a norm sample that attempted to replicate the general population rather than some subpopulation of persons with disabilities. Their manual does not really address the issue of normalcy, other than to note that it was necessary to normalise the composite and domain scores. They explained that their use of the term normalise meant 'to put the scores in the form of a normal curve'.

The two key mathematical determinations of a normal distribution are skew and kurtosis. In a normal distribution, both skew and kurtosis are zero. Skew deals with the length of the distribution tails, while kurtosis deals with the flatness vs. peakedness of the distribution. A distribution may be considered to be non-normal if the skew value exceeds two standard errors of skew, or if the kurtosis value exceeds 2.0 (or effectively, 2.0) standard errors of the kurtosis, the value is outside the 95% confidence interval around the ideal value of zero.

AIM

The aim of this study was to investigate the shape of the distribution of adaptive behaviour across two samples - one comprised of individuals with varying degrees of intellectual disability and the other sample from the general public.

METHOD

Study Participants

There were two groups of participants in this study. Group #1 was comprised of 2900 adults with intellectual disability who lived in a variety of residential settings in Oklahoma. They constituted a subset of all persons receiving residential services from the Oklahoma Department of Mental Retardation, and all were being followed as part of a routine programme evaluation effort. There were 1554 males and 1346 females. The mean age was 41.4 years (SD = 17.94). Group #2

was a sample of convenience, collected from adult colleagues, neighbours, and co-workers of the author. All were employed in or had retired from responsible professional positions. Positions included mechanic, veterinarian, psychologist, farmer, teacher, project planner, bank vice president, and butcher. There were 21 males and 16 females. The mean age was 52.81 years (standard deviation =11.81).

Instrument

Adaptive behaviour was assessed using a shortened form of the American Association on Mental Retardation's Adaptive Behaviour Scale (Nihira et al, 1974). This shortened version called the Behaviour Development Survey consists of 32 items, and yields scores that range from 0 - 128, with lower scores indicating lower levels of adaptive behaviour. The scale measures reported current performance in self-care skills, community living skills, and basic socialisation skills. All Behaviour Development Surveys were completed by third- party individuals who were familiar with the individual being assessed. For Group #2, the participants' adaptive behaviour was assessed by a knowledgeable third party in a manner consistent with described uses of the scale. In-house studies (Devlin, 1989) reveal an inter-rater reliability of .91 for this shortened form of the scale, a figure that is consistent with Isett and Spreat's (1979) report of the longer version of the scale.

RESULTS

The first analysis was completed on Group 1. The sample was divided by level of intellectual disability. There were 855 individuals with mild intellectual disability, 574 individuals with moderate intellectual disability, 627 individuals with severe intellectual disability, and 844 individuals with profound intellectual disability. For each of these four groups, the skew and kurtosis for the total adaptive behaviour score were calculated in an effort to assess the extent to which the data conformed to the properties of the normal curve. In a normal distribution, both skew and kurtosis are zero. A distribution may be considered to be significantly non-normal if the skew value exceeds zero plus/minus 2.0 standard errors of the skew or if the kurtosis value exceeds zero plus/minus two standard errors of the kurtosis. In a sense, this is merely stating that a derived value falls within or outside of the 95% confidence interval around the value of zero. For each of the four levels of intellectual disability, both the skew value exceeded 2.0 standard errors as calculated from the sample. Three of the four kurtosis values exceeded

2.0 standard errors of kurtosis as calculated from the sample. These data are presented in Table 1, clearly indicating that within each of these four subsamples, adaptive behaviour is not normally distributed.

Table 1: Distribution of Adaptive Behaviour among Individuals with Intellectual Disability

Level of Intellectual Disability	Skew	SE	Kurtosis	SE
Mild	-2.029	.084	4.961	.167
Moderate	-1.262	.102	1.491	.204
Severe	- .413	.098	-.950	.098
Profound	.754	.084	- .239	.168
TOTAL	**- .248**	**.040**	**-1.262**	**.080**

It is noted that the deviance from normal seems to increase as intellectual capabilities increase. While none of the four subsamples yielded normal adaptive behaviour data, the deviation from normalcy was less in the more challenged groups. Figure 1 illustrates the magnitude of the discrepancy from normal. It was constructed by dividing the determined skew and kurtosis values by the associated values associated with two standard errors. The Figure suggests that the deviation from normalcy increases as intellectual ability increases. Note that in this Figure, a value of zero for both skew and kurtosis would indicate normalcy.

Figure 1: Magnitude of the Discrepancy from Normal
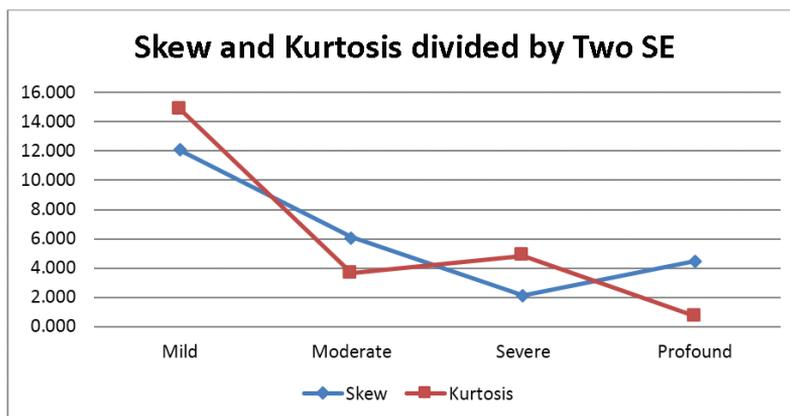
Analysis #2 consisted of calculating skew, kurtosis, and the associated standard errors from a convenience sample of persons without intellectual disability. The mean Behaviour Development Survey score was 127.46 out of a possible 128 points. The standard deviation was 1.48. Note first that 77.8 % of this sample achieved the highest possible scores on the adaptive behaviour Scale. All except one individual achieved scores in excess of 95% of the total possible, and this individual was 85 years of age and in declining health. The primary reasons for lost points were mobility challenges, urinary accidents in an individual who recently underwent prostate surgery, and retirement (which costs the individual one point on the Behaviour Development Survey). Skew and kurtosis, -3.99 and 18.28 respectively, both well exceeded two standard errors of the skew and kurtosis, indicating that the data was not normally distributed. These data reveal that there is very little variance in adaptive behaviour among adults without intellectual disability. It should be noted that while it would certainly be possible to use the standard deviation to establish cut off scores for having an adaptive behaviour challenge, it is not clear that the area of the curve cut off by 2 standard deviations would actually be the same as in the normal curve. It would not necessarily mean the bottom 2%. As an alternative, one could simply say that the bottom 2% equals a disability in adaptive behaviour, and the normal distribution was not pertinent. The Figure below illustrates the shape of the distribution, with a mean of 127.5 and a standard deviation of 1.48.

Figure 2: Behaviour Development Survey Scores of individuals without Intellectual Disability
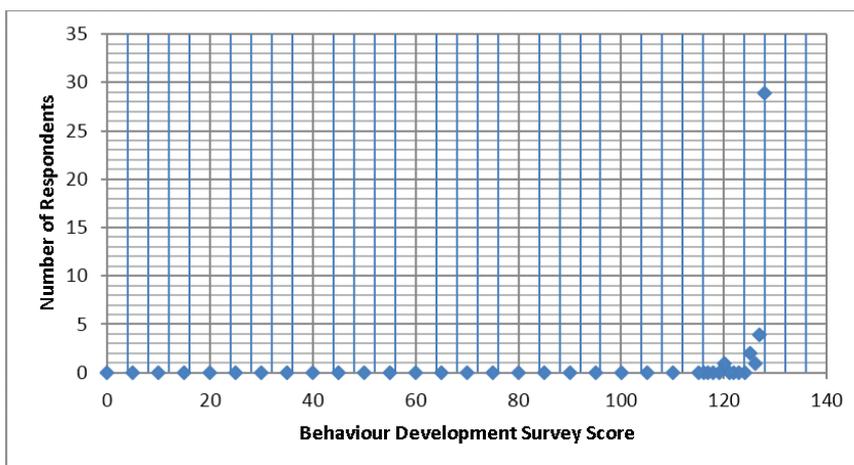
DISCUSSION

It may be noted that a similar argument was forwarded with regard to the "maladaptive behaviour" section (Part II) of the original AAMR Adaptive Behaviour Scale. McDevitt et al (1977) expressed the concern that the marked skew of Part II subscales threatened the interpretation of those subscales, noting that on some scales, any score at all would place an individual in the 70th percentile. They did mention the apparent normalness of the adaptive items, but this is perhaps attributable to the fact that the norm group was a group of persons living in state institutions, and perhaps, a normal distribution was to be expected in this more narrowly defined sample.

The presentation of adaptive behaviour collected from an intellectual disability sample and a convenience sample of adults without disability suggested that perhaps adaptive behaviour is not normally distributed. Data also suggested that the deviance from normalcy may increase as the individual's intellectual capabilities increase. Early literature on adaptive behaviour addressed the question of whether adaptive behaviour was distinct from IQ. These early studies typically involved correlating IQ and AB scores from various samples. Meyers et al (1979) reported on 25 such studies in which the adaptive behaviour correlation with IQ varied from .09 to .83. They went on to note that the low correlations found in normal children and in adults with mild intellectual disability were probably due, in part, to the ceiling effect of some adaptive behaviour scales. In a sense, the ceiling effect on adaptive behaviour scales can create a restriction of range among members of a more capable sample, such that a strong correlation is not possible. A ceiling effect is indicative of a non-normal distribution of data.

If the distribution of adaptive behaviour is not normal among adults in the general population, it makes little sense to apply a classification rule derived from the properties of the normal distribution. It is not so much that the establishment of a cut-off won't work, but rather that there is no mathematical surety about the meaning of that cut-off. In a non-normal distribution of data, it is not possible to know that two standard deviations from the mean reliably delineate the upper or lower 2.28% of the population.

A reasonable question might be related to the age of skill acquisition, such as is presented in the Vineland Adaptive Behaviour Scale (Sparrow et al, 2005). It is reasonable to speculate that the acquisition of adaptive behaviour skills might yield a normal distribution with respect to age of acquisition. For example, the act

of learning to tie shoelaces is typically achieved around age 5 or 6. Some children learn it at age 3, and others, like the author, did not learn to tie shoelaces until 8 years of age. If the acquisition of this skill follows a normal distribution with respect to age, it is possible to calculate the mean and standard deviation for age of acquisition, and percentile rankings can be calculated. A significant deficit in adaptive behaviour can be expressed in terms of acquisition age. If an individual has not learned a skill by age X, and 98% of persons of age X have attained that skill, the person in question has a significant deficit. Of course, the ramifications of this application are that diagnosis could only be done on individuals still in the developmental period. Further complicating this approach would be the incorporation of multiple criteria, each with different developmental profiles.

Greenspan (1999) has written about social intelligence as an important component of adaptive behaviour, suggesting that some of those more subtle deficits, such as credulity and gullibility may be better hallmarks of intellectual disability. It is reasonable to suspect that such traits might more closely approximate a normal distribution than does toileting or other primary activities of daily living. And would not toileting really be a diagnostic criterion only for younger children? If the individual does not have it by age 12, other problems are pretty evident as well.

CONCLUSION

The data in these analyses suggest that the distribution of adaptive behaviour increasingly deviates from normal as cognitive abilities rise. It cannot be assumed that two standard deviations below the mean on an adaptive behaviour instrument will reliably delineate the bottom 2% in the distribution. For this reason, the notion of significant deficits in adaptive behaviour needs to be re-conceptualised for use in defining intellectual disability. The re-conceptualisation might include reference to more subtle deficits that might approximate normalcy, or it might include reference to specific criteria.

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