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Design, Development and Validity Testing of the Gang Affiliation Risk Measure (GARM)

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Abstract

This study aimed to create a measure of risk for gang affiliation, for use in the UK. A pilot stage invited gang affiliated and non-gang affiliated participants between the ages of 16–25 years to retrospectively self-report on 58 items of risk exposure at the age of 11 years. Based on performance of these items, a 26-item measure was developed and administered to a main study sample (n=185) of gang affiliated and non-gang affiliated participants. Categorical Principal Component Analysis was applied to data, yielding a single-factor solution (historic lack of safety and current perception of threat). A 15-item gang affiliation risk measure (GARM) was subsequently created. The GARM demonstrated good internal consistency, construct validity and discriminative ability. Items from the GARM were then transformed to read prospectively, resulting in a test measure for predictive purposes (T-GARM). The T-GARM requires further validation regarding its predictive utility and generalisability. However, this study has resulted in the first measure of gang affiliation, with promising results.

Keywords: Gang, measure, risk, young people, UK

Introduction

The spread of gangs has been likened to epidemiological core infection, and social contagion models (Laumann & Youm, 1999; Fagan, Wilkinson & Davies, 2007), particularly in areas characterised by low socio-economic status (Gilman et al., 2003; Pyrooz, 2014; Raby & Jones, 2016). Whilst youth gangs are not a new phenomenon (Johnson & Muhlhausen, 2005), the relatively recent transnational extension of gang activity has resulted in a global security threat (Johnson & Muhlhausen, 2005) including in UK cities (Decker, 2007).

In the absence of a current universal definition of 'gang' (see Esbensen, Winfree, He & Taylor, 2001), this study has adopted the Eurogang definition (Weerman et al., 2009, p. 20):[1]

'[A gang is] any durable, street-oriented youth group whose involvement in illegal activity is part of its group identity.'

Esbenson and Huzinga (1993), Thornberry (1998) and Hill, Howell, Hawkins and Battin-Pearson (1999) have suggested that individuals drawn to gang affiliation are a vulnerable group, affected by compound risk exposure. A hypothetical developmental model for gang affiliation has been proposed by Howell and Egley (2005), which indicates that gang affiliated individuals have been exposed to risks across five separate domains (individual, family, peers, school and community), and that the cumulative nature of such exposure is an additional risk domain. Hill et al. (1999) found that individuals who had experienced seven or more risks within these domains were 13 times more likely to become gang affiliated than individuals exposed to one, or no risk factors. Furthermore, it has been demonstrated that this risk exposure journey begins at pre-school age and continues throughout childhood to a point of gang affiliation in mid-adolescence (Howell & Egley, 2005). Coid et al. (2013) argue that gang affiliation represents a major UK public mental health concern, and that violent victimisation is directly related to psychiatric consultation, admission and morbidity.

A recent systematic review, including 103 studies (Raby & Jones, 2016), identified both predictive risks (from studies utilising longitudinal designs) and associated risks (from studies using cross sectional designs) for gang affiliation. The overarching meta-narrative emerging from this review was of a failure to safeguard vulnerable individuals, which provided support for a relationship between developmental trauma and gang affiliation (cf.

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[1] The words 'affiliation' and 'involvement' will be used interchangeably with 'membership'.

Danyko et al., 2002; Institute of Psychiatry, Forensic and Neurodevelopmental Gangs Conference, 2015; Coid, personal communication, 2015).

A screening measure for risk of gang affiliation would enable vulnerable individuals to be identified, and offered targeted early intervention. This could reduce further psychological injury and the risk of gang affiliation. However, a lack of validated screening measures currently makes this impossible. Specifically, existing measures do not focus on gang affiliation risks per se. Furthermore, they have a country-specific bias.

Moreover, while the risk factors that emerged from the systematic review (Raby & Jones, 2016) could in principle be utilised as a foundation for such a screening measure, some caution needs to be exercised in this regard as only eight of the 103 included studies were conducted in the UK. Therefore, the development of a UK relevant screening measure needs to incorporate an examination of the factors that are associated with gang affiliation in this context.

Aims

Consequently, this study aimed to create a gang affiliation risk measure (GARM), sensitive to a UK context, by analysing the differences in historic risk exposure between gang affiliated and non-gang affiliated samples. Results from the systemic review (Raby & Jones, 2016) and intelligence sources (Home Office, 2013; IGU, 2013), supported by previous research findings (Pyrooz, 2014), indicated a particular vulnerability to gang affiliation upon transition to secondary school. Therefore, our ultimate aim was to develop a self-report questionnaire that could be given to children around the age of 11 years that could predict their risk of subsequently becoming gang affiliated. The validity of such a measure would ideally be determined in a longitudinal study, in which the questionnaire is administered at age 11 years and the participants are subsequently followed-up until around the age of 16 years, to see whether they become gang affiliated and whether their scores on the questionnaire (at age 11 years) are a good predictor of this. However, such a longitudinal study would require significant funding and also our research ethics committee raised concerns about starting this research programme with 11 year old participants.

Therefore, in order to provide a platform for funding and ethical clearance for a longitudinal study, we began this measure development research programme with the current retrospective study. More specifically, we sought to develop a self-report questionnaire that could discriminate between gang affiliated and non-gang affiliated 16 to 25 year olds, based on their responses to items about their experiences at the age of 11 years. Should the

questionnaire prove able to discriminate between these groups then we would have the basis for apply for funding to conduct the longitudinal study of the questionnaire's predictive validity, described above. As males were significantly over-represented in the gang affiliated population[2] (Decker & Pyrooz, 2013; Pyrooz & Sweeten, 2015; Farmer & Hairston, 2013), and the UK Office of the Children's Commissioner (2015) had undertaken extensive research on female gang affiliation, this study focused on a male population only.

The above described meta-aim of designing a retrospective male gang affiliation risk measure (GARM), sensitive to a UK context involved several micro-aims:

1. Creating a pilot gang affiliation risk measure (GARM).
2. Investigating the in-depth structure of the latent traits.
3. Identifying the construct validity of these factors.
4. Examining the reliability, internal consistency and factor structure of a final measure.
5. Testing the measure's discriminatory ability (as demonstrated by adequate sensitivity and specificity in detecting gang affiliation).

Method

Design

This study was undertaken in two stages. The first stage pertained to measure development and the creation of a pilot GARM (P-GARM) (see Appendix 1 in online materials). This included consultation with a range of experts to gain an improved understanding of whether risks identified in the systematic review (Raby & Jones, 2016) aligned with their operational or lived experience of gang affiliation in the UK. Thereafter, this stage involved a process of item design and selection for the P-GARM.

The second stage of the study focussed on measure testing. This initially involved testing the 58-item P-GARM on a pilot group, to examine item performance and assist decisions regarding item inclusion for the 26-item GARM (see Appendix 2 in online materials). Thereafter, the 26-item GARM was tested with the main study sample in order to analyse its factor structure, construct validity, internal consistency and discriminative ability. The results of this analysis informed item inclusion for the final 15-item GARM (see Table 2). Finally,

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[2] The Metropolitan Police Service Trident Matrix[2] stores information about currently known gang members. On 31/3/15, there were 3,651 gang members on this matrix; 99% were male, (MOPAC, 2015).

this was amended to create a predictive measure (T-GARM), which could be used in future longitudinal research (see Appendix 3 in online materials).

Participants

Study inclusion criteria, and sample demographics for both the pilot study and the main study are described in this section. The allocation of participants into the gang and non-gang affiliated groups is described in the measures section, and the recruitment of participants is covered in the procedures section.

Thirty-four participants (gang affiliated n=14; non-gang affiliated n=20) were involved in the pilot stage. Participants were male, aged between 16 and 25 years, and had been born and raised in the Borough of interest. As detailed in the aims section, the reason for including participants over the age of 16 years was largely directed by ethical considerations. Although this introduced some potential reporting bias (discussed further in the limitations section), there is no evidence from reviews (Raby & Jones, 2016; Esbensen, 2001; Klein, 1995) that reporting bias affects the efficacy or validity of self-report measures in gang affiliated participants. Furthermore, research suggests that when young people are directly asked about historic risk and abuse, they tend to offer accurate self-report, particularly when the abuser is well known to them (Reder & Lucey, 1995).

No further demographic information was gathered for the pilot study. This decision was based on experts by experience warning about hypervigilance amongst local gang affiliated individuals regarding undercover intelligence officers. They suggested that refraining from collecting demographic information in the early stages could increase trust in the authenticity of researchers collecting data for the purposes of the study only. It was considered that this could additionally assist with snowballing sampling thereafter. The pilot study participants were each given a £10 voucher to recognise their input in shaping the early stages of the measure.

For the main study, an additional 151 participants were recruited using the same criteria (gang affiliated n=68; non-gang affiliated n=83). Kline (1994) suggests that a sample size of 100 can be adequate for factor analysis when developing a measure. Ethics boards requested that further demographic information was collected for this group, including age, ethnicity, gender and sexuality in order to characterise the sample. By this stage, community trust had increased, making this more possible. It also allowed for the researchers to check that gang

and non-gang affiliated groups were comparable in profile (see Table 1). These data were kept separate from participants' responses to the measure.

The pilot study was treated as an internal pilot, and the data from this were added to the main sample data, resulting in a final sample size of N=185. This was considered appropriate by the expert group, researchers and a statistician, as the participants came from the same postcode area, with the same age range and gender, and had been through the same recruitment procedure. Non-gang affiliated and gang affiliated participants had similar characteristics, regarding ethnicity, with most participants self-identifying as Caribbean. All participants self-reported their sexuality as 'straight'. The mean age for both groups was approximately 19 years, differing only by 5.2 months. See Table 1 for details.

Table 1 here

Measures

Measures of gang affiliation

Whilst the heterogeneity of gang structures currently makes gang membership challenging to measure (Coid et al., 2013), Esbensen (2001) and Klein (1995) offer evidence of self-reporting being a sufficient methodology. Tapia's (2011) approach demonstrates how intelligence records can be additionally utilised, overcoming potential criticisms of self-report bias. A triangulated approach was therefore undertaken for this research, and participants were allocated to groups based on intelligence (London-wide and local intelligence sources) and self-report.

More specifically, the Metropolitan Police Service had a database of individuals they considered to be gang affiliated (the 'gang matrix'; Metropolitan Police Service, 2015) based on police intelligence, such as known gang association and gang related criminal activity. The Local Authority Gangs Unit had also created a local version of this database. From these intelligence sources, names of males thought to be gang affiliated and who met the study's inclusion criteria were extracted. This process was approved by three research ethics boards (see ethics section for further details).

In addition, at Local Authority Gangs Unit meetings, third-sector organisations shared their views on which individuals they believed to be gang affiliated with the primary researcher (and with explicit knowledge of participants who had shown an interest in being involved in

the research). Participants were also invited to self-report their gang affiliation status. All participants who were identified by the intelligence sources as being gang affiliated also self-reported that they were gang affiliated. Therefore, this group of participants was referred to as the 'triangulated gang affiliated group' and formed the sample of participants who we had greatest confidence in their gang affiliation.

In some cases, participants self-reported to be gang affiliated but had not been identified as such by police intelligence sources. One possible cause of this is that they had not been charged with gang-related criminal offences during the previous two years. In these cases, participants' self-report was supported by third-sector reports. These participants, together with those from the triangulated group, were referred to as the 'gang affiliated' group. Thus, this group comprised a wider sample of participants who appeared to be gang affiliated, while the triangulated group was a sub-sample of these who were almost certainly gang affiliated.

Participants who self-reported as being non-gang affiliated, and for whom there no evidence of gang involvement from intelligence sources, formed the non-gang affiliated group.

Pilot study measure

The 58-item Pilot Gang Affiliation Risk Measure (P-GARM) was used in the pilot study (see Appendix 1 in online materials). Time was incorporated for 'think alouds' (American Institute for Research, 2000), which are a recommended technique in measure development (Kline, 1994), enabling participants to clarify or discuss items. Exit interviews are also recommended (Kline, 1994; Wilson, 2005), offering participants the opportunity for reflection, post completion of the measure. Exit interviews focussed on missing items (by asking: "Is there anything you think we haven't asked you about, which you would say was an important risk for gang affiliation?), and reflections (both on the measure, and their involvement in the study).

Main study measure

The 26-item Gang Affiliation Risk Measure (GARM) was used in the main study (see Appendix 2 in online materials). Time was similarly incorporated for 'think alouds' and 'exit interviews, which asked the same questions as in the pilot study.

Procedure

Recruitment and consent

All participants had been born and raised in one London Borough, with low socio-economic status and high levels of gang related violence. Participants were recruited from schools, community settings and prisons. Of those incarcerated at the time of interview, some were accommodated in a prison outside of the Borough. In these instances, the prison they were accommodated in was visited, for interview purposes. In order to reduce response bias, no participants were known to the researchers.

For community interviews, the lead author undertook outreach to schools and community groups to inform people about the study, and assist in recruiting self-reporting participants. This led to snowball sampling (Saunders et al., 2003) through community workers and young people. Interested individuals received an information sheet. Thereafter, the lead author revisited the same settings to enable potential participants to enquire further about the study, before they signed the consent form, if they decided to participate.

Incarcerated individuals were written to with information about the study and invited to participate in the research. Prison officers talked through the decision with them, and created a list of interested participants. When interviewers met with them, they read through the information sheet once more, and potential participants had the opportunity to ask questions, before signing the consent form to participate.

Data collection

Measure development

To consult with national experts, the lead author attended an existing Home Office Ending Gang and Youth Violence (EGYV) national expert meeting. Local experts and previously gang affiliated young people (experts by experience) were consulted through a Local Authority Gangs Unit meeting.

A presentation was delivered to all expert groups regarding the research, and members were invited to submit factors (electronically) that they and their frontline teams deemed to be associated with gang affiliation. National and local intelligence officers further submitted six anonymised and pre-existing 'tracking maps' of gang affiliated individuals from birth to point of arrest, to assist in identifying individual risk factors.

Therefore, the lead author identified areas of risk to be included in the measure based on (i) a systematic review of the literature (Raby & Jones, 2016), (ii) the above-mentioned consultation with experts, and (iii) the ability for risk areas to be translated into self-report items. Included risk areas were translated into question items, in partnership with the local expert group.

Grouping of items was theoretically based on Howell and Egley's (2005) model and they were categorised into family, individual, peer and community sections. The Diagnostic and Statistical Manual of Mental Disorders (5th ed. DSM–5; American Psychiatric Association, 2013) Screening Interview for Adolescents (*SIfA*; Youth Justice Board, 2003) and The Mental Health Screening Questionnaire Interview for Adolescents (SQIfA; Youth Justice Board, 2003) were considered when mental health items were created for the measure, though their wording was novel.

Once a pool of items had been created, all stakeholders decided that the experts by experience group should have the final say regarding wording, as they wanted the questionnaire to incorporate language young people would use. The local expert group met four times, and individual members communicated back and forth (electronically) between meetings to produce the pilot measure (P-GARM). Following the pilot stage, the local expert group met once more, to decide on main study items.

Pilot and main study

Interviewers involved in the study were clinically trained and had experience of working with gang affiliated adolescents. Prior to meeting with participants, they role-played the use of the measure, and prompts were incorporated to increase consistency. Interviewers were encouraged to make observations and take notes throughout interviews, regarding respondents' engagement. Where two interviewers were present, they rotated the role of lead interviewer for each participant. Subsequent debriefing meetings enhanced the cohesion of interview style.

The Prison Reform Trust (2010) has suggested that at least 23% of UK young offenders have an IQ of less than 70. This led to the decision that interviewers would read out the measure for participants. It was further considered that this could improve interviewer's ability to identify any misinterpretation of items. Due to the potential sensitivity of the information elicited by the measure, participants were met with individually and in settings that provided them with sufficient privacy. In community-based interviews, interviewers met with

participants at a distance from other young people to ensure that responses were not overheard. Some interviews were conducted on a 1:1 basis, and wherever possible, a second interviewer was present. In prison-based interviews, participants were interviewed with two interviewers present for safety reasons; one interviewed whilst the second interviewer took notes. In two cases, prison officers were also present, due to risk issues, but not within easy earshot. The 58-item P-GARM took approximately 30 minutes to complete, and the 26-item GARM took approximately 20 minutes to complete.

Ethics

Approval for the study was obtained from a Canterbury Christ Church University Ethics Committee, the Local Authority Board of Ethical Standards, and the National Offender Management Service (NOMS) Board of Ethical Standards. Informed consent was obtained from all participants to be interviewed and for their gang affiliation to be cross checked against the police and local authority database. For participants between the ages of 16 and 18 years, in the care of the Local Authority, consent was sought from agencies in loco parentis as well as from the participants. Where participants were recruited from schools, parental consent was sought prior to interviews being conducted. Where one participant was unable to physically sign consent due to physical disabilities, a second interviewer signed that they had witnessed verbal consent. Particular consideration, time and attention was given to ensuring that incarcerated participants understood the nature of the research, and genuinely wanted to participate, after which they were given a consent sheet to sign. Participants were allocated codes, and responses were entered into an anonymised data sheet, to protect identity.

During prison visits, prison officers were allocated to interviewers. Unless participants were deemed to pose a direct risk to interviewers, prison officers waited outside interview rooms, which interviewers set up to ensure access to alarms and exits. The three interviewers were clinically trained psychologists or psychotherapists. If they observed any distress, the research protocol required that they overtly inquire about this, and subsequently direct participants to appropriate forms of support. In no cases did this circumstance arise. In fact, feedback from participants indicated that they felt positively about being involved in the research and/ or utilising their experiences of gang affiliation for a valuable purpose.

Individuals featuring on the matrix would have been overtly informed that their names were on this list at the time they were added, by the police. Ethics clearance was given for the lead author to use intelligence sources to strengthen the validity of the gang affiliated sample.

Despite this, time was spent reflecting further on the most ethical way to utilise such information, and how to mitigate associated risks; particularly for incarcerated participants. This led to a decision to only visit participants in prison settings once a non-gang affiliated sample group had been identified in the same establishment. It was, therefore, perceived that we were interviewing all individuals from the Borough of interest about how to reduce gang affiliation, as opposed to their participation being suggestive of gang affiliation per se. When alone with individuals, we had transparent conversations about their gang affiliation for the purposes of group allocation.

Although a response scale with multiple gradations can offer better sensitivity, when we consulted with our expert group in the development stage, they were clearly of the view that a scale with dichotomous responses would be preferable. This related particularly to previously gang affiliated young people's perspective that when answering about historic exposure to violence/abuse, they would rather quickly answer 'yes' or 'no' than provide a Likert rating, since they would need to think more deeply about the events to do the latter. We considered it important to respect their opinions. Furthermore, this fitted with our clinical experience of working with children who had experienced abuse and trauma, and we noted that child orientated clinical measures of trauma/ abuse, such as the Child Traumatic Stress Questionnaire (Brewin, Rose, Andrews, Green, Tata, McEvedy, ... & Foa, 2002) employed a dichotomous response scale. Considering that traumatic experiences were likely for this group, based on our systematic review of risk for gang affiliation (Raby & Jones, 2016), fixed 'yes' or 'no' responses were therefore selected, with a 'prefer not to say' option added.

It was explained to participants that they could request for their information to be retracted up to the point of publication, without repercussions. Results of this study have been summarised/ presented to Canterbury Christ Church University Ethics Committee, the Local Authority Board of Ethical Standards, the National Offender Management Service (NOMS) Board of Ethical Standards, the Director of Children's Services in the relevant Borough, the Local Authority Gangs Unit and the UK Home Office.

Analysis

Measure development

Items considered to have performed well in the pilot study were included in the main study, and items that performed poorly were eliminated; details follow in the results section.

Measure testing

Data were anonymized and entered into an IBS SPSS database, which was reviewed by the main author for input errors and accuracy. A statistician further verified all analyses. To investigate the structure of the latent traits and identify the construct validity of these factors, categorical principal components analysis (CatPCA) was employed, which aided decisions regarding item selection. Furthermore, decisions were informed by a Chi-squared analysis and the views of the expert groups. The internal consistency of the identified factor(s) were calculated using Cronbach's α. The study also aimed to test the measure's discriminative ability. Exploratory data analysis established that the non-parametric Mann-Whitney U and Kruskal-Wallis tests should be used to determine whether the total score significantly differed between groups. The Bonferonni correction was employed to ensure the robustness of multiple comparisons, and the measure's discriminative validity was tested using receiver operating characteristic (ROC) analysis.

Results

Measure Development

Consultation

In the consultation stage, there was consistent agreement on risk areas, within and between the local group, national group and experts by experience group. Fifty-eight items were developed and formed the P-GARM (see Appendix 1 in online materials). Following Wilson (2005), this initial version of the measure had a large enough item pool to extract a subsequent smaller selection of best performing items.

Pilot study feedback

Interviewers' notes from exit interviews suggested that the content was well matched to participants' understanding of risks associated with gang affiliation. One hundred and thirty two participants overtly remarked on the accuracy of risk items, and no participants noted any missing risk items in exit interviews. Observations from interviewers, notes from participant 'think-alouds' and exit interviews suggested that respondents had a shared understanding of the meaning of 26 items, but highlighted difficulties with 32 items. Following interviewer debriefs and a local expert meeting, all of these 32 items were eliminated.

Whilst two of the interviewers experienced participants as more receptive when employing wording selected by the experts by experience, one interviewer found the opposite. More

specifically, participants expressed to two of the interviewers that they were more inclined to participate honestly because they could see that other young people had shaped the wording. Conversely, one interviewer received feedback that it felt 'fake', and the interviewer reported feeling uncomfortable using 'slang' wording.[3] Considering that the measure would be used by a range of frontline staff, three items using 'slang' were re-worded to remove the slang, but in a way that the experts by experience continued to find accessible. All interviewers reported feeling comfortable using the revised items, and these items had the advantage that they would no longer become out-dated when slang changed. The resulting 26-item GARM for the main study can be found in Appendix 2 in the online material.

Measure Testing

Recall that the pilot group was treated as an internal pilot, with their data relating to final response items being added to the main study data. The analyses presented below were re-run with pilot group data removed, to ensure that potential minor differences of materials did not affect the observed result. This process supported inclusion of pilot data in the main analysis.

Testing item discrimination between groups

To test whether individual items discriminated between groups, chi-square tests were performed (see Appendix 4 in online materials). Results indicated that participants' responses on 15 items were associated with whether or not they were gang affiliated. Findings from this analysis were considered alongside the factor analysis in decision-making regarding item inclusion. This will be discussed in more detail shortly.

Factorability

CatPCA was used to reduce the 26-item data and explore underlying components (factors). The number of positive eigenvalues determines the number of factors required to represent a set of scores (Reitveld & Van Hout, 1993). It is recommended that factors with an eigenvalue of one or more should be retained (Guttman-Kaiser rule; Kaiser, 1960). Although scree plots are sometimes used to visualize cut-off points, these are unreliable for studies using sample sizes of under 200 (Yong & Pearce, 2013). Eigenvalues rather than scree plots have, therefore, been used. In an initial CatPCA analysis, seven factors emerged with eigenvalues above one.

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[3] In these interviews, 'think-alouds' allowed discussions to take place about the wording and involvement of experts by experience. This meant that rapport was not affected.

Hair et al. (1995) recommends that for a sample of 184, a loading size of 0.45 should be used as a cut off (eigenvalues for items across all seven factors can be seen in Appendix 5 in online materials). Insufficient primary loadings (i.e. < 0.45) led to the elimination of all factors, other than Factor 1. CatPCA was re-run on the items with factor loadings of 0.45 or above only. This did not result in any novel factors emerging with sufficiently strong loadings to be retained. Factor 1 accounted for 43% of the total variance, increasing confidence that this single factor was sufficient.

The Chi-squared results were then considered, alongside the Factor 1 loadings, to inform decision making regarding final item inclusion. Eleven of 14 items loading onto Factor 1 in the CatPCA analysis were also found to be significantly associated with gang affiliation in the earlier Chi-squared analysis. Only 4 of the 15 items identified as differing between groups by the Chi-squared analysis were not accounted for by Factor 1 (items 4, 5, 9 and 18).

CatPCA can detect underlying components, but allows for theoretical discussion to influence practical decisions, regarding models. A discussion with the local expert group, research team, interviewers and statistician followed. It was decided that items loading onto Factor 1 appeared to be describing 'historic lack of safety and current perception of threat'. Items 4, 5, 9 and 18 fitted this construct. Although these items had Factor 1 loadings of < .45, they appeared to load to some degree (> .3). It was agreed that if the addition of these items would not affect the internal consistency of the factor significantly, they should be included. Subsequent ROC analysis supported this decision, as inclusion of these items led to increased discriminatory ability of the overall measure.

Factor 1 included three items that the Chi-squared results indicated not to be discriminatory (items 13, 23 and 24). Although at least the latter two of these items potentially fitted with the construct of 'historic lack of safety and current perception of threat' (items 23 and 24), it was decided that if removal of these items would not affect the internal consistency of the measure significantly, they should be removed. This was partly as the focus was on developing a measure to identify a difference between gang affiliated and non-gang affiliated participants, and Chi-squared results suggested that these items would not assist in this task. Furthermore, other items did discriminate, and the elimination of these weaker items would reduce the length of the measure.

Internal consistency

The internal consistency of Factor 1 was assessed by calculating Cronbach's α coefficients. Using George and Mallery's (2003) guidelines to interpret the results, Factor 1 demonstrated

'good' internal consistency when all items were included (Cronbach's α = .87), and 'acceptable' internal consistency (Cronbach's α = .78) when only the 14 items with loading values > .45 were retained. Cronbach's α was re-run when the four items identified as differentiating between gang affiliated and non-gang affiliated groups (by Chi-squared results) were added to the 14 items. This resulted in a 'good' Cronbach's α of .84, validating the inclusion of these items due to their theoretical fit, and also due to internal consistency being improved.

The three items not identified as significant by Chi-squared results, but which Factor 1 had originally included, were not considered to fit the construct as well as others. They were eliminated, which did not affect internal consistency. The above analyses led to the decision to settle on a15-item measure (Cronbach's α = .84) that included the four items that did not adequately load onto Factor 1 but nevertheless discriminated between groups, and excluded the three items for which the reverse was the case (see Table 2 for the15-item GARM).

Table 2 here

A total score for risk of gang affiliation was thereafter computed by counting how many of these 15 items the respondent had responded 'yes' to, resulting in a score ranging between 0 and 15. A higher score should, therefore, indicate a greater risk of gang affiliation. Computing a total score allowed subsequent analysis to compare groups' scores and test the discriminative ability of the GARM.

Differences in total scores between groups

In comparing the GARM scores between the gang affiliated group and non-gang affiliated group, a Mann-Whitney U test indicated that scores were significantly greater for the gang affiliated group ($Md = 8.25$, $n = 102$) than the non-gang affiliated group ($Md = 4.60$, $n = 81$), $U = 1832.00$, $z = -6.45$, $p < .001$, $r = -.48$.

Recall that the gang affiliated group also contained the more stringently defined t*riangulated gang affiliated group*, meaning that the gang affiliated group could potentially be sub-divided into two groups (self-reporting gang affiliated group $n = 56$, and triangulated gang affiliated group $n = 46$). A Kruskal-Wallis test indicated a significant difference in GARM scores between these three groups, $\chi2$ (2, $n = 183$) = 55.12, $p < .001$. As expected, the triangulated gang affiliated group recorded a significantly higher median score ($Md = 9.80$) than the self-reporting gang affiliated group ($Md = 6.98$; $U = -729.00$, $z = -3.772$, $p = < .001$, $r = -.37$),

which in turn had significantly higher median than the non-gang affiliated group ($Md = 4.59$; $U = 1405.50$, $z = -3.80$, $p = < .001$, $r = -.32$). These findings remained significant when the Bonferroni correction for multiple comparisons was applied.

Discriminant validity

The discriminant validity of GARM was examined through ROC analysis. ROC curves provide a complete measure of accuracy by plotting discriminative ability (true positive rate by false positive rate) across the whole spectrum of potential cut offs (Kumar & Indrayan, 2011). For the purposes of this study, every cut-off point indicated a score above which participants were judged to be at risk of gang affiliation. Initially, an ROC curve was calculated for the discrimination between the gang affiliated and non-gang affiliated groups. Subsequently, an ROC curve was calculated between the triangulated gang affiliated and non-gang affiliated groups. The two ROC curves can be seen in Figures 1 and 2. Both of these curves are above the diagonal 'line,' and have a highly significant ($p < 0.01$) area under the curve (AUC) of .78 and .89 respectively, which classify this a 'good' and 'very good' discriminatory measure (Choi, 1998). These results support the discriminative ability of GARM as a measure of gang affiliation.

Figure 1 and Figure 2 here

Although the analysis including the triangulated gang affiliated group resulted in a higher AUC, it was considered that using this ROC curve to determine the cut-off might be overly conservative, given the stringent criteria for membership of the triangulated gang affiliated group. Instead, as the questionnaire was being designed as a preventative measure, a cut-off point was calculated from the first ROC analysis (see Figure 1). The highest Youden's score was 0.43, which was associated with cut-off scores of both 6.5 and 7.5. Using a cut-off 6.5, the sensitivity (i.e. the probability of a true positive) was 0.66, and the specificity (i.e. the probability of a true negative) was 0.77. For the 7.5 cut-off, the sensitivity was 0.57 and the specificity 0.85. The former cut-off of 6.5 was preferred, in order to favour sensitivity. Therefore, given that the GARM total score could only take integer values, participants needed to answer 'yes' to seven or more items out of the 15 in order to be classified by the measure as being at risk of gang affiliation.

T-GARM:

Although GARM is of use in its own right, the overarching aim of this study was begin the process of developing a predictive measure, to guide early intervention and prevention. Therefore, the wording of questions from the GARM was adjusted to convert it from a retrospective to a prospective measure that could be used in future research. This process resulted in the T-GARM (see Appendix 3 in the online materials). An opportunistic sample (N=5) of 11–13 year olds reviewed the wording of the T-GARM and deemed it as accessible to this age group, suggesting that this measure could be applied prior to transition to secondary school.

Discussion

This study aimed to begin the process of developing a measure that could predict the risk of young males becoming gang affiliated in future. In order to provide a platform for funding and ethical clearance for a future longitudinal study, we began with the current retrospective study. In particular, we sought to develop a self-report questionnaire that could discriminate between gang affiliated and non-gang affiliated 16 to 25 year old males, based on their responses to items about their experiences at the age of 11 years.

Input from experts, and consideration of previous review findings (Raby & Jones, 2016) led to the development and pilot testing of a 58-items. This was reduced to the 26-item that performed well with participants and had high face validity (based on 'speak alouds' and 'exit interview' feedback). A subsequent CatPCA analysis of these items suggested a single-factor solution, namely historic lack of safety and current perception of threat. Drawing on this analysis and on an examination of the ability of individual items to discriminate between gang affiliated and non-gang affiliated participants, the final 15-items were selected. These formed the GARM. Internal consistency for GARM was good, and ROC analysis evidenced its ability to discriminate between gang affiliated and non-gang affiliated individuals. A version of the GARM that could be used prospectively in a subsequent longitudinal study was also created; namely the T-GARM.

With regard to the content of the GARM and T-GARM, the 15 items concerned a lack of parental supervision, school exclusion, a lack financial security, violent victimisation, violence exposure, social modelling of violence, violence perpetration and PTSD symptomology. These fitted the emergent meta-narrative from the systematic review (Raby & Jones, 2016), linking a failure to safeguard young people with gang affiliation, and

identifying increased violence exposure and associated psychological consequences, namely developmental trauma or PTSD (cf. IoP, Gangs Conference, 2015; Coid et al., 2013; Coid, personal communication, 2015). Consistent with this, neurodevelopmental studies of early attachment difficulties and complex trauma have associated a historic lack of safety with ongoing hypervigilance and increased threat perception (Meloy, 1992; Rogers, Harvey & Law, 2015; Shore, 2005).

These risks identified by the GARM as having been experienced by participants by the age of 11 years support the argument for early intervention and prevention. It would additionally seem plausible that proactively meeting these needs could increase resilience, and reduce the lure of gangs. Furthermore, the findings of this study are consistent with previous theoretical findings regarding compound risk exposures experienced by gang affiliated individuals (Esbensen & Huzina, 1998; Thornberry, 1998; Hill et al., 1999), and the GARM's cut-off of responding yes to seven or more items was of particular interest given Hill et al.'s (1999) observation that gang affiliated young people exposed to ≥7 risk factors were 13 times more likely to become gang affiliated than their control group.

Considering the proposed epidemiological core infection model (Laumann & Youm, 1999; Fagan et al., 2007), this area of policy and practice requires assertive attention to ensure that gang related violence is not offered fertile ground to spread, particularly in urban areas characterised by low socio-economic status (Pyrooz, 2014; Gilman et al., 2003; Pyrooz, 2014; Dupure et al., 2007). However, this is likely to create challenges in the UK, given the recent significant cuts to local authority budgets (Local Authority Association, 2014).

Limitations

The current study has a number of limitations. Firstly, many potential predictor items identified by the systematic review (Raby & Jones, 2016) were excluded from the measure based lack of compatibility with self-report, due to potential lack of insight, knowledge or poor performance of items in the pilot stage.

Secondly, owing to the retrospective nature of the study, it is possible that the findings of the study have been confounded by memory biases, given that participants were asked to retrospectively report on their experiences at the age of 11 years. For example, it may be that, because of their subsequent experiences, participants who were gang affiliated were more likely to have a hostility bias and therefore were more likely to rate their past as having

contained hostile and threatening events than non-gang affiliated participants, even if it did not. However, it is doubtful that memory biases can fully explain the ability of the measure to discriminate between gang affiliated participants and non-gang affiliated participants, as many of the measure's items are consistent with the existing evidence (Raby & Jones, 2016) that suggests that these factors do discriminate between gang affiliation and non-gang affiliation. Furthermore, to the best of our knowledge, there is no evidence from systematic reviews that memory biases affect the reliability or validity of self-report measures (Raby & Jones, 2016). On the contrary, there is evidence that indicates that when children are directly asked about historic abuse (as they are in some of the measure's items), they tend not to falsely self-report, but rather provide accurate self-report, particularly when related to people with whom they have a close personal relationship (e.g. Reder & Lucey, 1995).

Thirdly, participants were recruited from one Borough, and testing of the measure's psychometric properties with other samples is necessary to strengthen the generalizable of the conclusions. Fourthly, although based on advice received from the experts by experience group, not having collected full demographic data for the pilot group raises a question as to whether this group presented with a similar demographic profile to the main study sample. However, the tight inclusion criteria and interviewer feedback suggest that they do represent the same population, and reanalysis with removal of pilot data indicated that the inclusion of this group did not materially alter the pattern of findings in the main study.

In summary, we would argue that the current study provides a solid foundation to the development of a measure that can predict the risk of 11 year-old males subsequently joining gangs. The next step in the measure development process should be to conduct a longitudinal study, of the sort described in the introduction, to examine the predictive validity of the T-GARM. Such a study would further address a number of the limitations described above.

Clinical Implications

Results of this study suggest that gang affiliated participants had been less protected and more frequently exposed to violence (both at home and in the community) by the age of 11 years, than non-gang affiliated participants. Violent relational experiences in childhood frequently result in symptoms of 'PTSD' or 'developmental trauma' (Steiner, Garcia, & Matthews, 1997; van der Kolk, 2007; Schmid, Petermann & Fegert, 2013, Ford & Courtois, 2013; Treisman, 2017).

Although conduct disorder (CD) (Lahey et al., 1999; Howell & Egley, 2005; Madden, 2013) and antisocial personality disorder (Coid et al., 2013; Valdez et al., 2000) have also been associated with gang affiliation, it is essential that clinicians accurately differentiate conduct disorder presentations from post-traumatic reactions to violence exposure, or behaviours intrinsic to gang affiliation. For example, running away from home on two occasions (a symptom of CD in The Diagnostic and Statistical Manual of Mental Disorders 5th ed. (DSM-V); American Psychiatric Association (APA), 2013) could be explained by avoiding violence, or young people's involvement in 'county lines' (Home Office, 2014). Going missing could, therefore, indicate safeguarding concerns relating to exploitation, as opposed to being symptomatic of an intrinsic mental health difficulty. It would appear more likely (given that violence exposure and violent victimisation *distinguished* this group from the non-gang affiliated group) that antisocial behaviour has manifested as a fear-based post-traumatic reaction to perceived threat, or due to reduced emotional awareness (Lambie & Marcel, 2002) which is a known deficit resulting from developmental trauma and insecure attachment (Van der Kolk & d'Andrea, 2010; Ford & Courtois, 2013). Social modelling of problem solving using instrumental violence must also be considered.

It has been suggested that PTSD symptomology is experienced differently by gender (Kerig & Becker, 2010). Dulmus and Hilarski (2006) found that boys who had witnessed domestic violence in their early years frequently displayed externalised (as opposed to internalised) PTSD symptoms. Maschi, Morgen, Bradley and Hatcher (2008) discovered a causal link for externalised PTSD symptoms, tempered by gender, resulting in males 'acting out' or demonstrating offending behaviour in response to childhood victimisation (contrasting to females who tended to internalise their aggression). They consequently argue for a gender sensitive response to developmental trauma.

The findings of this study echoed this research. The sense of 'going it alone' to survive that Maschi et al. (2008) describe in male trauma survivors was as evident in the symptoms this cohort reported (aggressive thoughts, sense of foreshortened future, hypervigilance and violence perpetration) as the internalised ones they denied (fear, avoidance, anxiety and nightmares) and the self-protective style with which this was reported. That internalised symptoms did not discriminate between groups, in this study, may therefore reflect on the gender moderation of PTSD symptomology, and reporting bias in this particular cohort (perhaps to psychologically defend themselves against experiencing or presenting with weakness).

Identification and treatment of developmental trauma or PTSD can reduce cyclic victimisation and violence commission (Ruchkin et al., 2007). Robust age-appropriate screening measures and evidence based treatment should be employed to identify and treat those in need of mental health support, and reduce ongoing offending behaviour (Paton, Crouch & Camic, 2009). Results of this study suggest that reporting internalised post-traumatic symptoms could feel understandably challenging for this cohort (given that they have experienced a historic lack of protection from harm, or violence exposure from primary caregivers). It therefore, seems appropriate to recommend that diagnostic interviews are sensitive to the likelihood of attachment difficulties, developmental trauma and the under-reporting of internalised symptoms.

The GARM should enable individuals vulnerable to gang affiliation to be better identified, allowing for targeted early intervention and prevention. Promisingly, evidence suggests that gang affiliated individuals are more committed to treatment than non-affiliated individuals (Coid et al., 2013). However, postcode territories, the stigma of mental health difficulties, the risk of being perceived as weak, and an inherent lack of trust in authority could make accessing help challenging. This should be considered when designing interventions, to overcome potential obstacles to engagement (Department of Health, 2013; MAC-UK, personal communication, 2015). Partner agencies from across the statutory and voluntary sector should work together to ensure accessible services, tailored to meet the holistic needs of gang affiliated young people. Given the results of this study regarding the impact of traumatic exposure, interventions should feature specialist psychological support.

If the increased threat to public safety presented by gang violence is explained through an epidemiological core infection model, results of this study would propose that accurate early identification of young people at risk of gang affiliation and preventative holistic support (including targeted mental health treatment) would likely be a highly-effective antidote.

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Table 1

Demographic Information for the Main Study Sample

Demographic Information	Sample group (n=87)	Control group (n=64)
Missing data	3	2
Mean age[4]	19.78	19.16
Mode age	18	18
SD (age)	3.18	2.65
Ethnicity		
Asian other	1	1
Kurdish	1	0
White other	4	0
Turkish	1	1
Pakistani	0	3
Indian	2	1
Black British	5	1
Other mixed	3	1
Black other	4	2
White British	10	12
Bangladeshi	7	2
Caribbean	23	17
African	20	10
White & Black African	3	11
Sexuality		
Straight	84	62

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[4]The mean, mode and median scores have been calculated based on dates of birth at the end of the study.

Table 2

Gang Affiliation Risk Measure (GARM)

15-item G. A. R. M.

| Question No.	Question	Response (Y/N)
1	Had you witnessed violence at home?	
2	Did the people who lived with you sort out problems using violence?	
3	Did you usually tell your family where you were going, when you went out?	
4	When you got home from school, did anyone ask you how your day had been?	
5	Was your biological father living at home with you?	
6	Did you get kicked out of school at any point?	
7	Were you aware of post-code gangs in your area?	
8	Had you witnessed violence in your area?	
9	Did you think it was easier to make money through gang involvement rather than getting a job?	
10	Had you regularly heard about people being shot, stabbed or killed in your area?	
11	Had you been badly beaten up?	
12	Had you been in trouble for fighting or hurting other people?	
13	Did you *often* have aggressive thoughts?	
14	Did you have the sense that life would be short?	
15	In your area, did you feel that you had to look over your shoulder all the time, to stay safe?	
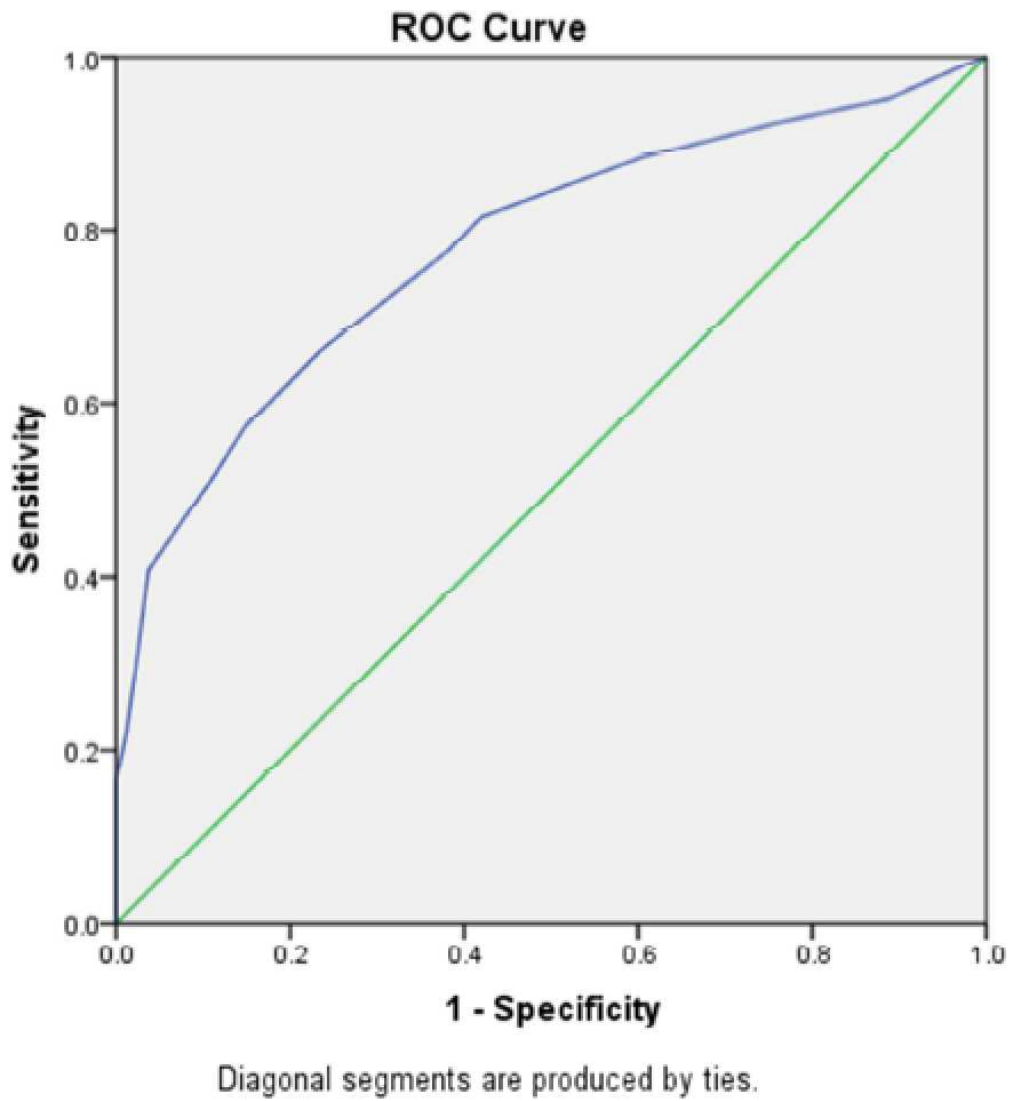
Fig. 1: ROC curve for GARM total score (total gang-affiliated group compared to total non gang-affiliated
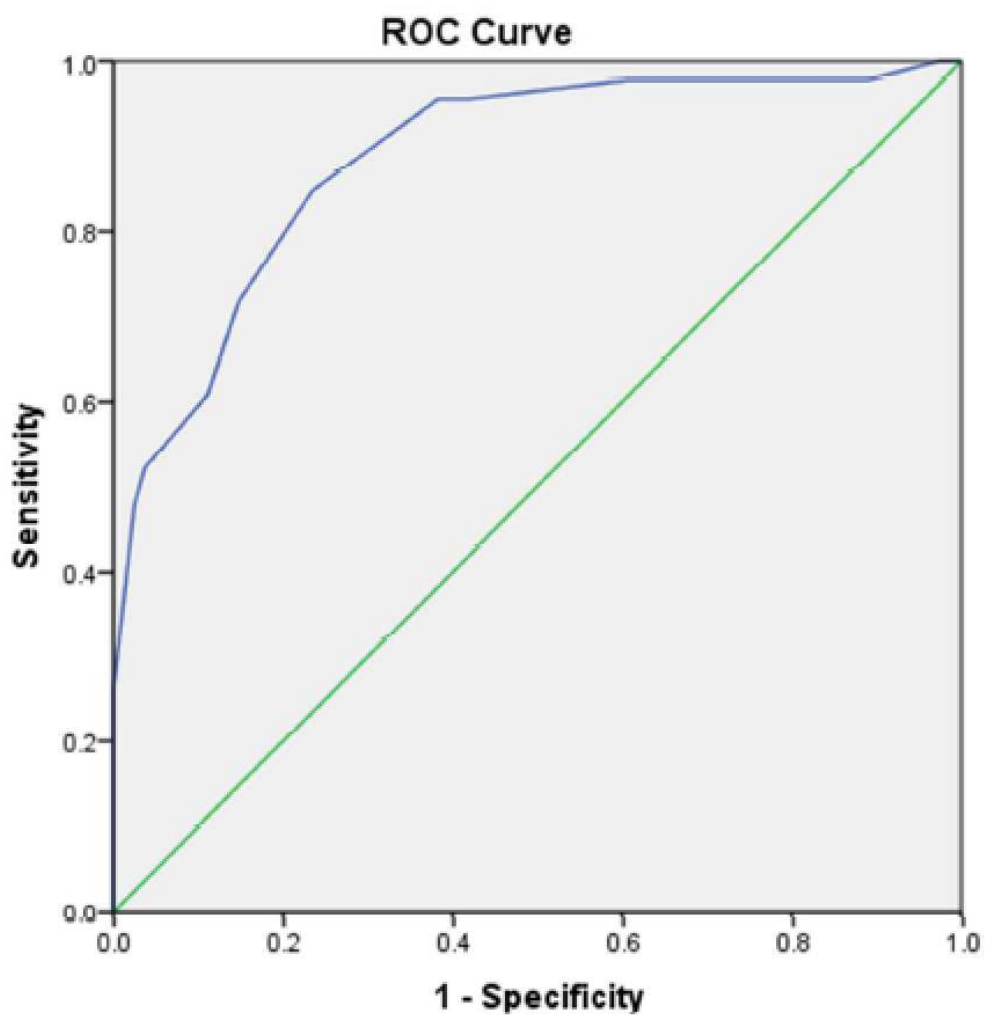
Diagonal segments are produced by ties.

Fig. 2: ROC curve for GARM total score (matrix gang-affiliated group compared to total non gang-affiliated

group)