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Social Organization in Prison: A Social Network Analysis of Interpersonal Relationships among Dutch prisoners

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ABSTRACT

The current study examined the structure of social relations among Dutch prisoners using a social network perspective. Data came from the Life-in-Custody-study (LIC-study), a nationwide prospective study designed to examine the quality of prison life in the Netherlands. We used a subsample of 233 male prisoners from nine prison units for whom additional network data was collected using peer nominations to indicate who they get along with most. Exponential Random Graph Models revealed that network structure in prison resembles known friendship network structure outside prison, including reciprocity and transitivity in social ties (“the friends of my friends are my friends”) and homophily (i.e., a preference for similar others) on major sociodemographic dimensions such as religion and age. In conclusion, this study shows that a social network approach leads to valuable insights in social organization in prison that are also relevant for prison policy.

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Introduction

Currently, the worldwide prison population counts over 10 million people and, on a yearly basis, about 33,000 persons enter Dutch prisons (De Loeff, Van de Haar, Van Gemmert, & Valstar, 2017; Walmsley, 2015). This “era of mass incarceration” has been accompanied by a spike in prison research, especially focusing on the (unintended) individual and collateral consequences of imprisonment, such as effects on ex-inmate mental and physical health, employment, and the socio-developmental costs to partners, children, friends, and communities (e.g., Pager, 2003; Visher & Travis, 2003; Volker et al., 2016). In order to contextualize and prevent incarceration’s many negative consequences, a detailed understanding of the contemporary circumstances of imprisonment is necessary. Social organization in prison – more specifically the social relationships *within* prison – is one of the main dimensions that make up the prison climate and determines how prisoners experience and are impacted by their

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imprisonment (Boone, Athoff, & Koenraadt, 2016). The current study will extend an emergent carceral literature to quantify and examine the structure of interpersonal relations among Dutch prisoners using a social network perspective.

Social relations in prison

The importance of social relations for one's wellbeing has been consistently shown in a long tradition of sociological and psychological research (Baumeister & Leary, 1995; Durkheim, 1951). The need to belong or the need for connectedness is presented as a fundamental human motivation across age, contexts, and cultures. In light of this fundamental need to belong, the context of imprisonment is particularly interesting for multiple reasons. First, prisoners are, by design, disconnected from regular contact with their community and family ties. Maintaining social relationships outside of prison is challenging given the restricted means and moments to communicate (Bronson, 2008). As such, fellow prisoners are often the only directly available sources to fulfill the need for social connectedness. However, the involuntary nature of imprisonment and the concentration of high-risk individuals make prison a particularly treacherous environment for relationship formation. Prisoners have limited interaction choices and the pool of available interactants are likely to be demographically heterogeneous (Wakefield & Uggen, 2010) yet criminally homogenous. The combination of high levels of surveillance and formal control with social environments where trust and supportive social bonds are in short supply (Liebling & Arnold, 2012) makes prison a unique context to study social relationships.

Social relations in prison may serve a number of functions. In general, interpersonal relations provide social support that can be instrumental (e.g., practical help, getting something done) or emotional (e.g., affection, caring). In one of the first and most influential studies on social relationships in prison, Sykes (1958) found that the deprivations common to prison underlie the informal roles in prison society. Accordingly, prisoners adapt to the 'pains of imprisonment' by either exploiting their peers (instrumental) or fostering community solidarity (emotional) to minimize collective deprivations and resist institutional dehumanization. Although not guaranteed, Sykes recognized that prisoner peer relations may ease the pains of imprisonment.

Subsequent research using a similar ethnographic method further documented three important features of prisoner relationships. First, research concluded that the foundation of social relations in prison is built around trust (Bronson, 2008; Severance, 2005). In interviews with prisoners it became clear that prisoners were very selective in whom to befriend in prison and that the formation of social bonds included a process of careful observation and evaluation of others. Only those fellow prisoners who they felt they can trust, for instance those with whom they can discuss personal matters and who are loyal and reliable, were selected to form friendships with (Bronson, 2008). Second, studies found that friendships in prison can provide prisoners with emotional support (Bronson, 2008; Wulf-Ludden, 2013), although inconsistent results exist regarding the beneficial effects of these friendships. Some studies reported associations between prisoners' friendships and more hostility (Beer, Morgan, Garland, & Spanierman, 2007; Lindquist, 2000) whereas others found associations with greater wellbeing (Hart, 1995), and most of these results differed for men and women. Third,

prison ethnographies found that social structures in prison generally mirrored the social structures outside prison (Irwin & Cressey, 1962). That is, relationships were often based on similarities in age, race, religion, educational level, or other demographic characteristics (Bronson, 2008; Crewe, 2009; Shrivastava, 1973; Skarbek, 2014; Trammell, 2009).

Most of these studies on social relations among prisoners have taken a descriptive, qualitative, or individual-centered approach to document subjective social support or friendships in prison (Desmond, 1991; Gallagher, 1990; Lindquist, 2000). These studies are informative, but also leave important questions unanswered regarding larger social structures and group cohesion in prison. Instead of examining *if* prisoners are socially connected, the current study will examine *who* is connected *with whom* by focusing on prisoners' socio-demographic characteristics – drawing on previous ethnographic studies – while simultaneously accounting for the prison network structure as a whole. Extending our knowledge on network formation and its correlates in prison is also highly relevant for prison policy as it can inform on strategies for unit composition and the stimulation of positive peer relations in prison, which will ultimately benefit the prisoners and the overall prison climate. To this end, we will apply a social network perspective to investigate the network structure of social relations among prisoners (cf. Kreager, Schaefer, 2016).

A social network perspective

Over the last few decades there has been a rapid growth in sociological research that applies a social network approach to study the interdependence between persons and their social environments (Borgatti, Mehra, Brass, & Labianca, 2009; Veenstra, Dijkstra, & Kreager, 2018). A social network is typically defined as a set of individuals within a bounded setting who are connected through measureable social ties, such as friendships. A social network approach acknowledges individual agency in network formation (e.g., self-selection processes in relationships) as well as the interdependence of individual characteristics as affecting network structure. In turn, network structure is assumed to influence individual outcomes over time (Steglich, Snijders, & Pearson, 2010; Veenstra et al., 2018). A large part of the sociological network research focused on adolescents' friendship networks in schools to explain changes in behavioral outcomes and vice versa (see for an overview Veenstra, Dijkstra, Steglich, & Van Zalk, 2013).

These network studies proved particularly useful in quantifying three key features in social relationships. First, they quantified the level of social embeddedness (the *density* of a social network). This concept refers to the actual number of social ties between actors in the network relative to all possible ties. The denser a social network, the more the individuals within the network are connected, i.e., the more social ties exist. The densities reported in adolescent social network studies are almost always less than 50%, and the density for positive ties, such as friendships, is usually much higher than for negative ties, such as bullying (Veenstra et al., 2013). Second, these studies quantified the tendency to form relations with whom one shares a common friend (so-called *transitivity*). This means that the likelihood of a social tie between two

actors in a network depends on the degree to which they have other ties in common; “the friend of my friend is also my friend”. Third, these studies quantified the tendency to form relations with others in the network who are similar (i.e., *homophily*). This preference for similar others is found across a range of contexts, such as marriage, friendships and work-related connections (McPherson, Smith-Lovin, & Cook, 2001). A preference for similar others is found in terms of (aggressive) behaviors and attitudes, but also for demographic characteristics such as gender, ethnicity, age, or religion. More recently, this network approach was also introduced in criminology to study adolescents’ delinquency and network structure of gangs (Grund & Densley, 2015; Papachristos, 2013; Weerman, 2011).

In the current study, the social network pertains to the relationships among prisoners within Dutch prison units. This study is one of the first to apply a social network approach to the context of prison, following recent research in the United States (Kreager et al., 2017; Schaefer, Bouchard, Young, & Kreager, 2017). In a medium security prison unit of 205 male prisoners, Schaefer et al. (2017) found that the prison network structure resembled the abovementioned adolescent network structures in schools: Social ties among prisoners tended to be reciprocal and transitive (“the friends of my friends are also my friends”) and clear patterns of homophily – a preference for similar others – were found for age, race, religion, and time spent in prison. In addition, they found that the ‘old heads’ – prisoners who were older and/or who had spent more time in prison – were the most central (connected) in the prison unit network (Kreager et al., 2017; Schaefer et al., 2017). There are, however, important differences in the American and Dutch prison context that may have consequences for conclusions on network structure and prisoners’ positions and preferences therein. In addition, the American prison networks studies (PINS) focus on a single “good behavior” prison unit, so their generalizability is questionable. This study thus extends the unit-level prisoner network research to an international context across multiple prison settings.

Dutch versus American prison context

After a few decades of steep increases in imprisonment rates following policies less lenient towards crime and more supportive of punishment and retribution (Boone & Moerings, 2007), the Dutch detainee population decreased by more than twenty percent between 2012 and 2016. As a result, today the Netherlands has one of the lowest detainee populations of Western Europe at around 51 detainees per 100,000 inhabitants (Aebi, Tiago, Berger-Kolopp, & Burkhardt, 2018). This amounts to a total number of 33,000 incarcerated adults each year (De Loeff et al., 2017). There are separate facilities for men and women, but most offenders (92%) detained in the Netherlands are males (De Loeff et al., 2017).

Although the Dutch prison system has been challenged by a series of budget cuts, the prison service continues to strive towards a positive and humane social climate evidenced by prison regimes with daily schedules consisting of work, education, and recreation. In addition, prison-staff is unarmed and the majority of the population (around eighty percent) is detained in single-cells which are assembled in relatively

small sections (24 to 48 cells per unit). Compared to prison sentences in other countries, prison sentences in the Netherlands are fairly short: Roughly sixty percent of all offenders that enter the Dutch penitentiary system are detained for a period no longer than three months while over seventy percent of them are released after having spent less than six months in a Dutch prison facility (De Looft et al., 2017).

Dutch prisons run different regimes depending on the type of detainee. The two most common regimes are remand centers where adults are held in pre-trial detention (who have not yet been convicted) and the 'regular' prison regime for adults who have been convicted of an offense. In addition, vulnerable prisoners – due to the nature of their offense or mental health issues – are detained in extra care units. Prisoners with severe mental health issues are detained in psychiatric penitentiary facilities. Lastly, there are special units for offenders who have received a two-year prison sentence as a result of persistent offending (see Moerings, 2007). Besides operating different regimes, Dutch prison units vary in security level; there are high security units meant for terrorists and other high-risk prisoners, and minimum security units where detainees (in the final months of their prison term) are allowed more freedom and are sometimes allowed to retain regular daytime activities (such as school or work) and return to prison only at night. It is relevant to note that Dutch prisons can have a mix of regimes and populations, including pretrial regimes, regimes for convicted and sentenced individuals, maximum security regimes, and open regimes. There are a few relatively large facilities that hold between 500 and 800 individuals, but most hold between 150 and 500 individuals.

In sum, the most important differences between prison conditions in the Netherlands and in the United States (and, to some extent, other European countries) are a low detainee population (with the consequence of no overcrowding), relatively small units (24–48 cells) in which prisoners reside and interact, the use of individual cells for the majority of prisoners, and relatively short prison sentences. These differences may have consequences for the in-prison social networks, to which we now turn.

The current study

The current study applies a social network approach to examine the structure of relationships among prisoners. We focus on socio-demographic factors to explain the network structure (such as homophily) and prisoners' positions in the network (i.e., their popularity and sociality, corresponding to their incoming and outgoing social ties, respectively). The units of analysis are Dutch prison units and include their resident prisoners and peer relationships among those residents. The use of social network analysis permits us to quantify the processes typically found in other (qualitative) prison studies, and to test the *relative* contribution of socio-demographic factors while accounting for aforementioned structural network characteristics (density, reciprocity, and transitivity). As such, the study will contribute to a more complete picture of social connectedness and peer integration in prison. Given the novelty of this approach in the prison context, hypotheses will be based on known friendship network structures outside prison that were discussed above, and a comparison to a

similar network study in a single American prison unit (PINS; see Kreager et al., 2017; Schaefer et al., 2017).

First, the Dutch prison context is characterized by relatively short sentence lengths. Relatively short prison sentences and associated high turnover rates might cause difficulties building trusting relationships with fellow prisoners (see also Kreager, Palmen, Dirkzwager, & Nieuwbeerta, 2016). In addition to the limited time required to establish trusting and meaningful connections, prisoners with short sentence lengths may remain strongly connected to those outside of prison and see limited value in creating strong prison-based ties. With respect to aggregate network structure, this may translate into a relatively low network *density* (H1) – the amount of relationship ties in the network – as compared to other friendship network studies in schools or American prison settings. Because trusting and supportive social bonds are already in short supply (Bronson, 2008; Liebling & Arnold, 2012), we further hypothesize that prison peer ties that do develop will likely be reciprocal and based on a mutual friend so as to minimize risk. This would translate into a network structure characterized by *reciprocity* (H2) and *transitivity* (H3), consistent with other friendship network studies. Next, as mentioned earlier the American prison network study found that prisoners who resided longer on the unit or in prison and/or who were older – the so called “old heads” – had a more central position in the network (Kreager et al., 2017; Schaefer et al., 2017). But in the Dutch prison context with relatively short sentences, such an “old head” system should be less likely as compared to the United States. Thus, consistent with H1, we do not hypothesize to find “old heads” in central positions of the network, indicated by no clear effects of age or prison tenure on receiving (*popularity*) or sending (*sociality*) social ties (H4). Lastly, we hypothesize that prisoners have a preference for similar others (H5), with regards to behavior and the major sociodemographic dimensions that also stratify society, including ethnicity, age, and religion given the pervasiveness of this *homophily* phenomenon across social contexts (cf. McPherson et al., 2001).

Method

Sample

Data from the Life-in-Custody-study (LIC-study) were used, which is a nationwide prospective study designed to examine the quality of prison life in the Netherlands. The target population of the LIC-study consisted of the full population of pre-trial detainees and prisoners, housed in all penitentiary institutions in the Netherlands ($n = 28$), in the period of January till April 2017.¹ The LIC-study focuses on adult male and female prisoners, in different phases of punishment (pre-trial and convicted prisoners), and in regimes that vary in security level (from minimum to maximum security) and target population (regular regimes, terrorist regimes, regimes for persistent offenders, and extra care units), and combines various data sources (e.g., self-reported data and

¹Prisoners in psychiatric institutions and immigration detention were not targeted in this study, because many questions in the survey did not apply and they were expected to need a different approach due to psychological and linguistic needs.

register data from the Dutch Custodial Agency). In total, 4,938 prisoners participated in the study, which amounts to a high response rate of 81%. Details on the LIC-study sample and non-participants can be found in van Ginneken, Palmen, Bosma, Nieuwbeerta, and Berghuis (2018).

The current study used a subsample of LIC-study participants, for whom additionally collected social network data were combined with the LIC-study register data. The network study was carried out in two penitentiary institutions in the Netherlands in March and April 2017. Within these two penitentiary institutions, prisoners from all units were eligible for participation in the network study, amounting to a total of 282 male prisoners across 14 units. Of these eligible prisoners, 235 agreed to participate (response rate of 83%). The most common reasons to decline participation were distrust concerning research or simply not feeling like it.

Not all 14 prison units were eligible for social network analysis. Results from simulation studies show that social network parameters are robust to approximately 30% missingness (Kossinets, 2006). Therefore, we selected units that had less than 30% missingness on the network questions (i.e., participation rate of 70% or higher) and a unit size of 20 prisoners or more to facilitate model convergence in estimating network structure. As such, we dropped 5 units prior to analysis: 3 units consisted of less than 20 prisoners (ranging from 8 to 11 prisoners), 1 unit had more than 30% non-participation (participation rate of 67%), and 1 unit was dropped due to a low number of social ties that precluded the estimation of a social network structure (16 ties in total, density less than 3%). We thus retained 9 units from two penitentiary institutions for our analyses.

The retained 9 units consisted of 233 prisoners of which 183 (79%) actively participated in the network study. Those who did not participate were also included in the network analyses, since they could still be nominated by others while their outdegrees (nominating others) were missing and hence set to zero (see Measures and Analytic Strategy). Units consisted on average of 26 prisoners (*range* 24–29). The prisoners were on average 37.5 years old (*range* 19–70), predominantly Dutch (66.1%), and at the time of data-collection had spent on average 26 months in prison of which on average 7.5 months on the current unit. While the average time spent on the unit was 7.5 months, 50% of the prisoners had been currently on the unit for a maximum of three months, whereas only 25% had currently spent more than nine months on the unit. Similarly, the average time prisoners had currently spent in prison (regardless of the location) was 26 months, whereas 50% had currently spent a maximum of 15 months in prison and only 25% had spent more than 33 months in prison. These numbers are consistent with the relatively low prison sentences in the Netherlands. Sample characteristics are summarized in [Table 1](#).

Procedure

The first phase of LIC data collection included site visits to all Dutch prisons. During these visits, researchers contacted staff members and prisoner representatives. Data collection procedures were explained, possible practical difficulties (e.g., involving daily schedules of prisoners) were discussed, and promotional material was distributed

Table 1. Descriptive Statistics (n = 233 across 9 prison units).

	Mean or %	SD	Min	Max
<i>Unit level</i>				
Number of prisoners in unit	26	1.61	24	29
Number of ties in unit	42	11.58	27	59
Density in unit	6.6%	2.1%	3.8%	10.7%
Reciprocity in unit	17.3%	6.9%	7.4%	30%
Average indegree (received nominations)	1.62	1.34	1	2.46
Average outdegree (given nominations)	1.62	1.98	1	2.46
<i>Individual level</i>				
Indegree (received nominations)	1.58	1.41	0	6
Outdegree (given nominations)	1.64	2.08	0	10
Education				
Low	69.9%			
Middle	20.2%			
High	9.9%			
Ethnicity				
Dutch	66.1%			
Antillean	8.6%			
Surinamese	3.0%			
Moroccan	3.4%			
Turkish	3.0%			
Other	15.9%			
Religion				
Christian	30.9%			
Muslim	26.6%			
None	33.9%			
Other	8.6%			
Offense type - violent	50.2%			
Age	37.5	12.5	19.3	70.2
Unit tenure (months)	7.5	13.5	0.13	150.8
Prison tenure (months)	26.1	34.5	0.36	267.9

(flyers and posters to announce our upcoming visit among prisoners and prison staff). During the week of data collection, research assistants personally invited detainees to participate in the study at their cell doors. All prisoners (including non-participants) received a small incentive (a small snack) as a conversation starter. All prisoners were explained the purpose of the study and voluntary nature of taking part in it (following current research ethics). After giving permission for taking part in the LIC-study, participants were asked permission to match their survey data with administrative data, which 92% of the prisoners agreed to. Subsequently, prisoners were handed a paper and pencil version of the questionnaire in their language of preference (Dutch, English, or Spanish). In cases of reading or concentration difficulties, assistance in filling out the questionnaire could be given by the research assistants. Questionnaires were collected by the research assistants in the same week, and prison staff members were instructed not to take in any questionnaires for reasons of confidentiality. A more extensive overview of the procedure and questionnaire of the Life-in-Custody Study can be found in van Ginneken et al. (2018).

When the completed LIC questionnaires were picked up by the research assistants, stopping by each prisoner's cell, prisoners in the current subsample were asked if they wanted to answer four additional questions on the social climate in the unit. This approach was taken to ensure that the response of the LIC survey would not be compromised. The social network questions were conducted verbally and the answers were written down by the research assistant and immediately put in a closed

Table 2. Descriptive statistics of the peer nominations for ‘who do you get along with most?’ (n = 233).

	n	%	cum. %
<i>Nominations sent (outdegree)</i>			
0	98	42.1	42.1
1	33	14.2	56.3
2	41	17.6	73.9
3	32	13.7	87.6
4	10	4.3	91.9
5	6	2.6	94.5
6	5	2.1	96.6
7	1	0.4	97.0
8	1	0.4	97.4
9	3	1.3	98.7
10	3	1.3	100.0
<i>Nominations received (indegree)</i>			
0	63	27.0	27.0
1	62	26.6	53.6
2	52	22.4	76.0
3	32	13.7	89.7
4	15	6.4	96.1
5	7	3.0	99.1
6	2	0.9	100.0

envelope to alleviate confidentiality concerns. The research assistants stated that anonymity was guaranteed when processing the data and that individual answers would not be shared with prison staff, fellow prisoners, or third parties other than the researchers involved. Participation in the network study was voluntary. We had access to prison administrative data for all prisoners in this subsample.

Measures

Social relations between prisoners

The social network questionnaire consisted of four questions regarding social climate on the unit. For the present study, we were interested in the positive relations between prisoners, asked by the question: “Who do you get along with most (on the unit)?”. This network question is similar to friendship nominations in other contexts (e.g., high schools) and replicates the item used by Schaefer et al. (2017) in an American prison unit. Prisoners could answer the question by nominating up to ten fellow prisoners within their own unit. Although ten was chosen as a maximum, this number was rarely reached with an overall mean of 1.64 nominations per respondent (see Table 1). The majority (94%) nominated five or less fellow prisoners (see Table 2). Only three prisoners nominated the maximum of ten unit peers. The research assistants carried a complete up-to-date list of all the current prisoners in the unit to facilitate the peer nominations. The answers to this question formed the network of social ties on the unit level. For each prison unit, a matrix was created consisting of zero’s and one’s, indicating absence or presence of a tie from one prisoner to another. All ingoing and outgoing ties are part of the social network, regardless of whether or not a tie was reciprocated. This is accounted for in the analyses by the inclusion of a reciprocity parameter (see Analytic Strategy).

Educational level

In the LIC survey, participants were asked about the highest level of education they had completed. They could choose from (1) none, (2) primary education, (3) lower secondary education (up to age 16), (4) higher secondary education (ages 17–18), (5) intermediate vocational education, (6) higher vocational education, and (7) post-secondary academic education. Consistent with the categorization of the Statistics Netherlands (Centraal Bureau voor de Statistiek; CBS) we reduced the seven educational categories to three: Low (1–3), Middle (4–5), and High (6–7). Educational level was pulled from the LIC survey data and had missing values for 19% of our sample, which could be due to either non-participation in LIC or anonymous participation that prevented us from merging the data sources for those prisoners. To retain all 233 participants in the analyses, we replaced missing values on educational level with the variable mode, which was a value of (1), or category “Low”.

Ethnicity

For each prisoner, country of birth was registered at prison entry. The distribution of country of birth among the Netherlands, Netherlands Antilles, Surinam, Morocco, Turkey, and Other is summarized in [Table 1](#). The percentages in the categories other than Netherlands were relatively low and not consistently present in every prison unit, so we created a dummy variable indicating Dutch (1) versus non-Dutch (0) for the social network analyses.

Religion

Administrative data also included whether prisoners considered themselves as religious. We categorized religion into (1) Christian (including Catholic and Protestant), (2) Muslim, (3) No religion, and (4) Other (see [Table 1](#)).

Violent offense

Based on the registered offense prisoners were sentenced for, we created a dummy variable indicating a (1) Violent offense versus (0) Non-violent offense. About half of our sample (50.2%) had committed a violent offense. Having committed a violent offense served as a proxy for aggressive behavior.

Unit tenure (months)

We calculated the time prisoners had spent on the current unit (in months) from the registered date a prisoner entered the current prison unit and the date of data collection. This variable was log-transformed before entering the social network analyses to adjust for its non-normal (right skewed) distribution.

Prison tenure (months)

Similarly, we calculated the time prisoners had spent currently in prison (in months) from the registered date a prisoner had begun his current prison sentence (irrespective of whether that was in a different unit or prison location) and the date of data collection. Again, this variable was log-transformed before entering the social network analysis to adjust for its non-normal (right skewed) distribution.

Analytic strategy

Exponential random graph models

To analyze prison unit network structure and its association with socio-demographic attributes, we estimated Exponential-family Random Graph Models (ERGMs) with the ‘statnet’ package (Handcock et al., 2016; Handcock, Hunter, Butts, Goodreau, & Morris, 2008) in R 3.5.0 (www.r-project.org). ERGMs produce parameters that represent network configurations – subsets of actors with specific patterns of ties - that lead to the social structure of the observed network. The program uses the Markov chain Monte Carlo (MCMC) algorithm for parameter estimation. The social networks were unit-based and constructed from the “get along with most” peer nominations. The networks consisted of all prisoners within each unit; when prisoners did not participate, their outdegree (ties sent) was set to 0 but they, of course, could still be nominated by others.

The estimated models included two types of parameters. First, we included *structural network effects* to control for model structure: The “edges” term captures the *density* of a network and was included to model the overall likelihood to observe a tie. The “mutual” term captures *reciprocity* and models the likelihood that an observed tie is being reciprocated. The “gwesp” term captures the geometrically weighted edge-wise shared partner distribution, which models the likelihood of a tie between prisoners who share a tie with someone else (i.e., *transitivity*). Lastly, the “gwidegree” term captures the *indegree distribution* and controls for the large differences that may exist in prisoners’ number of incoming nominations. Although different structural parameters are available, this set of parameters have previously been shown to reflect the basic structure in friendship networks in other contexts (Veenstra et al., 2013).

Second, we included socio-demographic attribute effects that may be associated with the observed social network structure. There are three types of attribute effects: *popularity/receiver* effects, named “indegree” effects in the software, to model the probability of receiving a tie given the actor’s attribute value; *sociality/sender* effects, named “outdegree” effects in the software, to model the probability of sending a tie given the actor’s attribute value; and *homophily/similarity* effects, to model the probability of a tie when two actors share the same attribute’s value. For categorical variables (ethnicity, religion, offense type), homophily was measured as two actors having the exact same value on the attribute (named “match”). For continuous variables (age, unit tenure, prison tenure), homophily was measured as the absolute difference between two actors on the attribute value (named “difference”), with smaller differences indicating stronger homophily.

Model fit

The effects were added progressively to the model until model convergence and goodness of fit indices were satisfactory. When effects caused model degeneracy, their decay parameters were fixed after which model convergence and goodness of fit were reevaluated. Model fit was evaluated with the goodness of fit diagnostics available in the ‘statnet’ package. The goodness of fit function simulates networks from the ERGM estimates and compares the distribution in the simulated networks to the observed values (Hunter, Goodreau, & Handcock, 2008). Diagnostic information comprised statistics indicating the differences between the observed network and simulations from

the model for all parameters included in the model, and visual representations (plots) of observed versus simulated network distributions of indegree, edgewise shared partners, and geodesic distance. For each estimated model the goodness of fit was evaluated with these diagnostics. Based on these goodness of fit diagnostics, the final models reported in this paper had a satisfactory model fit.

Meta-analysis

The ERGM analyses resulted in a set of parameter estimates and standard errors for each prison unit. To summarize these findings over the nine sampled units, we combined the ERGM results in a meta-analytic procedure as described in Lubbers and Snijders (2007). This procedure uses a multilevel regression model in which it is assumed that each network has a true parameter, which is estimated with some estimation error. The true parameters are distributed across networks according to a normal distribution, while the estimation errors are independently and normally distributed, with a mean of 0 and a standard deviation equal to the estimated standard error. Estimation of this model with iterated weighted least squares was carried out using the program MLwiN (Rasbash et al., 2000). The obtained estimated mean parameter represents an unstandardized aggregated estimate across prison units, and the accompanying standard deviation represents the degree to which the estimate varied across prison units. The statistical significance of the mean parameters was tested by dividing the estimate by its standard error using a t-ratio, which has approximately a normal distribution. The significance of the standard deviations was tested using a chi-square difference test with one degree of freedom.

Results

Network descriptive statistics

In Table 1, it is shown that on average, prisoners nominated 1.6 fellow prisoners whom they get along with most. About 17% of these nominations were reciprocated. The average density indicates that about 6.6% of all the theoretically possible ties in a unit actually existed. In Table 2, more information on the raw numbers of peer nominations can be found. In response to the question whom prisoners get along with most on the unit, the majority of the prisoners did not nominate more than four or five fellow prisoners. About 42% ($n=98$) of the prisoners did not nominate any fellow prisoner, which seems consistent with the prison context and difficulties with trust. Note that this percentage also included non-respondents, whose outdegree was set to zero, but who could still be nominated by others. Consistent with the outgoing nominations, the majority of the prisoners (96%) did not receive more than four nominations, and none of the prisoners received more than six nominations.

The nine social networks are depicted in Figure 1 for visual inspection of network structure. An interesting structural similarity between the units is that each has a single connected component along with a few isolates or disconnected dyads or triads. There are also some apparent between-unit structural differences, primarily related to the structure of the connected component, with some of these clusters forming relatively dense core-periphery structures (top left) or multiple cliques connected through

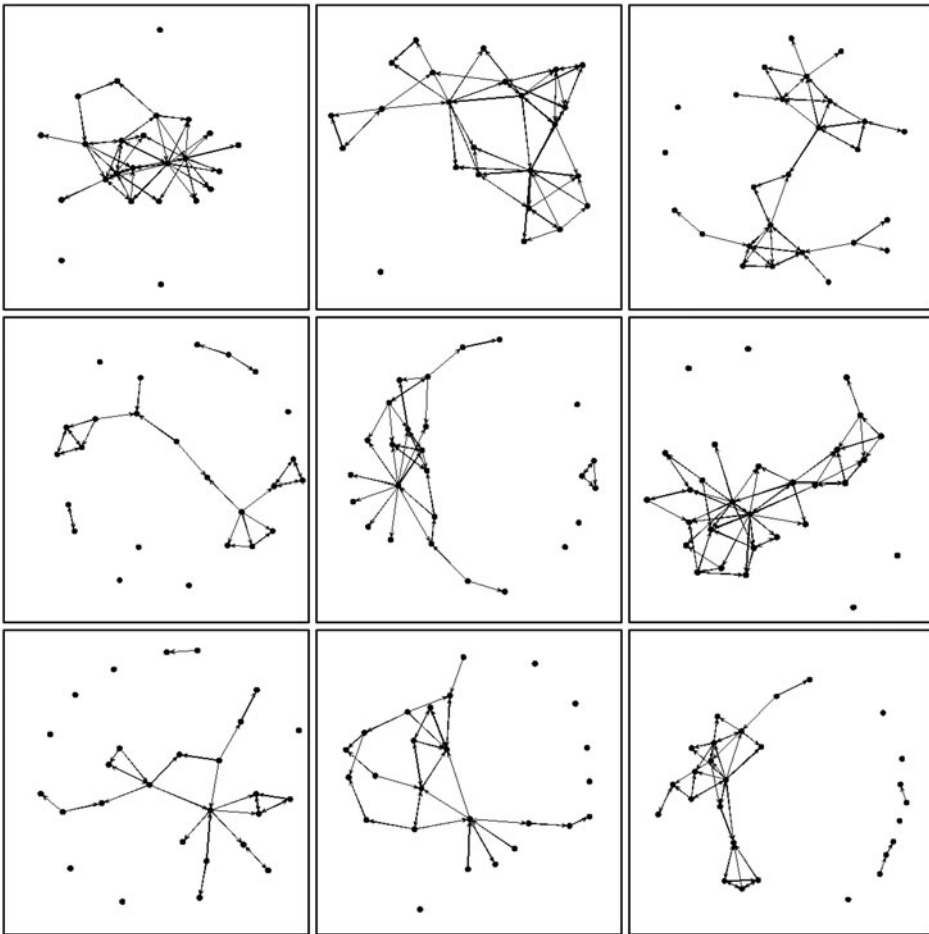


Figure 1. Social network structure in nine Dutch prison units.

bridging ties (top right). We further explore the structural properties of these networks in the next section.

Social network analyses

To explore the network structure of prisoners' social ties and to test whether socio-demographic factors were associated with this network structure, we performed unit-based ERGMs. The meta-analytic parameter estimates are reported in Table 3 and should be read as effects on the probability of observing a tie between two prisoners.

Structural network effects

First, we added a set of structural effects to account for the consistently found structures in friendship networks. These effects pertain to the first three hypotheses on prison network structure. The significant and negative *density* parameter in Table 3 indicates that less than half of all possible ties were observed in the data, meaning that prisoners nominated less than half of their fellow prisoners for getting along with

Table 3. Meta-analytic coefficients and standard deviations from the exponential random graph models (n = 233 across 9 prison units).

Parameter	Mean coefficient		Standard deviation	
	Estimate	SE	Estimate	χ^2
<i>Structural network effects</i>				
Density ("edges")	-5.26**	0.52	0	0
Reciprocity ("mutual")	1.79**	0.31	0.34	27.31**
Transitivity ("gwesp")	0.96**	0.10	0	0
Dispersed Indegrees ("gwidegree")	1.99**	0.62	1.59	38.37**
<i>Popularity (receiver) effects</i>				
Education indegree	-0.08	0.21	0.24	46.81**
Dutch ethnicity indegree	0.31	0.22	0.08	1.41
Violent offense indegree	0.21	0.24	0.18	9.54**
vAge indegree	0.01	0.01	0	17.09**
Unit tenure (log) indegree	0.14	0.11	0.04	7.94**
Prison tenure (log) indegree	0.17	0.13	0.05	12.65**
<i>Sociality (sender) effects</i>				
Education outdegree	0.24*	0.10	0	0
Dutch ethnicity outdegree	0.03	0.31	0.62	112.92**
Violent offense outdegree	-0.22	0.21	0.17	25.46**
Age outdegree	0.01	0.01	0.01	58.86**
Unit tenure (log) outdegree	0.10	0.07	0.01	10.63**
Prison tenure (log) outdegree	-0.12	0.08	0	0
<i>Homophily (similarity) effects</i>				
Dutch ethnicity match	0.22 [†]	0.13	0	0
Religion match - Muslim	0.80*	0.33	0.47	52.90**
Violent offense match	0.21 [†]	0.11	0.01	6.24*
Age difference	-0.03**	0.01	0	9.49**
Unit tenure (log) difference	-0.15**	0.06	0	0
Prison tenure (log) difference	-0.18*	0.07	0.01	10.86**

Note. The mean coefficient represents the unstandardized aggregated parameter estimate across prison units. The standard deviation represents the variation of the parameter estimate between prison units. The degrees of freedom for the χ^2 test was 1.

[†] < .10.

* p < .05.

** p < .01.

most (H1). The significant and positive *reciprocity* parameter indicates that social ties were likely to be reciprocated, more than would be expected based on chance (H2). The significant and positive *transitivity* parameter indicates that triadic closure was observed in the network structure of ties, meaning that a tie was more likely when two prisoners shared tie with someone else (H3). Lastly, the significant and positive *indegree* parameter indicates a dispersed distribution of indegrees, meaning that some prisoners were clearly nominated more often than others. *Attribute effects.* For each attribute, we included all three possible effects (indegree, outdegree, and homophily) except when problems with model convergence and/or model fit prevented us from doing so.² As can be seen from Table 3, none of the indegree effects, which correspond to prisoners' *popularity* in the network, were significant. This means that the likelihood to receive nominations was not dependent on prisoners' educational level, ethnicity, offense type, age, or prison experience. In addition, of the outdegree effects, which correspond to prisoners' *sociality*, only the effect of educational level was significant. The positive parameter indicates that

²The inclusion of the indegree and outdegree effects for religion and the homophily effect for educational level led to estimation errors and produced infinite parameters (indicating model degeneracy). Thus, these effects were removed from the final model.

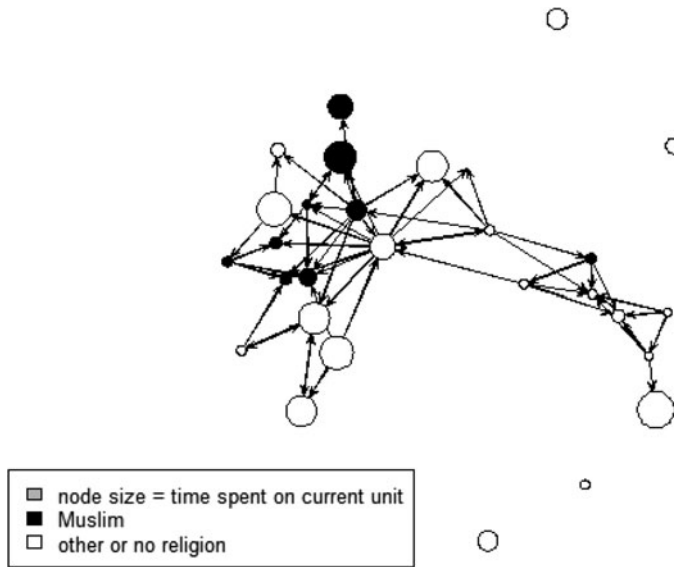


Figure 2. Example unit-level social network based on the question ‘Who do you get along with most?’, with nodes colored by religion and sized by time spent on current unit ($n = 29$).

prisoners with a higher educational level had higher outdegrees, and thus were more likely nominate fellow prisoners than those with a lower educational level. None of the other socio-demographic attributes were associated with the likelihood to send nominations. Thus, in line with our hypotheses that highlight important differences between the American and Dutch prison context, prisoners who were older or who had spent more time in prison or on the unit were not more central in the network and thus not more likely to receive or send nominations than others (H4).

Last, with the exception of two marginally significant effects, all *homophily* effects were significant, corresponding to a preference for similar others that resulted in a network structure characterized by socio-demographic clustering (H5). Remember that with respect to the categorical variables, homophily was measured as the likelihood to observe a tie between two prisoners with the exact same value (‘match’) on the attribute. There was a tendency towards ethnic homophily in that a tie was 1.25 times more likely between two Dutch prisoners than between prisoners with different ethnicities ($\exp(0.22)$, $p < .10$). In addition, we found a strong homophily effect of religion. This effect was inspected for each religion category separately and it appeared that the only stably significant homophily effect was found for Muslims. Hence, this effect was retained in the final model and the positive coefficient reported in [Table 3](#) indicates that a tie was 2.2 times more likely to occur between two Muslim prisoners as compared to ties between prisoners with different religions ($\exp(0.80)$, $p < .05$). As a visual example, [Figure 2](#) plots the social network of one of the units where Muslims clearly cluster in the social structure.³ Next, there was a tendency towards homophily in offense type, indicating that a tie was 1.23 times more likely between two prisoners

³Figures from all units showing any of the included effects/variables are available upon request from the first author.

who both had committed a violent offense as compared to prisoners who had committed different types of offenses (exp (0.21), $p < .10$).

As for the continuous variables, homophily was indicated by the likelihood to observe a tie between two prisoners with smaller differences in the attribute value (measured as absolute differences). The significant and negative effect for age difference indicates that larger differences in age decreased the probability of a tie and, conversely, that smaller age differences between two prisoners increased the likelihood of a tie. Similarly, the significant and negative effects of unit and prison tenure difference indicate that larger differences between two prisoners in the amount of time they had spent on the unit or in prison decreased the probability of tie, and that smaller differences in time spent increased the likelihood of a tie. Together, the difference effects indicate a preference for others who are similar in age, prison- and unit experience.

Discussion

The current study set out to examine the network structure of social relations among prisoners using a social network perspective (cf. Kreager, Palmen, et al., 2016). The advantage of a social network perspective is that it acknowledges the interdependence between individuals and their social context – here referring to the web of relationships between prisoners within Dutch prison units – and that characteristics of individuals as well as characteristics of their social ties and structure at large can be modeled simultaneously. In detail, focusing on prisoners' positive "get along with most" relationships, we examined how prisoners' socio-demographic characteristics contributed to overall network structure (e.g., homophily) and their position in the network (their sociality and popularity). Social network analysis was performed for each prison unit followed by a meta-analysis (cf. Lubbers & Snijders, 2007) to generalize findings across prison units. The quantification of the network structure in Dutch prison makes it possible to directly compare our findings to other network studies, which is important given the growing "replication crisis" in the social sciences (Simons, 2014). Below, we discuss and evaluate our results against knowledge from school based network studies (Goodreau, Kitts, & Morris, 2009; Veenstra et al., 2013), the recent American prison network study (Schaefer et al., 2017), and other prison studies.

Prison network structure

First and foremost, the current study shows that interpersonal relationships among prisoners can be studied using a social network perspective and that this perspective adds distinct information to the knowledge gained from other (e.g., ethnographic) prison studies. Findings from our study go beyond the individual perspective and indicate that prisoners' network structure, for the most part, resembles friendship networks in other contexts. Most importantly, our study illustrates that prisoners are able to form relationships characterized by reciprocity and transitivity. As such, in-prison social networks are structurally comparable to adolescents' friendship networks in school (Borgatti et al., 2009; Goodreau et al., 2009; Veenstra et al., 2013).

The most apparent structural difference lies in the network density, referring to the relative number of social ties measured by the peer nominations: Whereas we found that prisoners nominate on average 1.6 fellow prisoners as friends, amounting to on average 40 social ties per unit, similar friendship nominations among adolescents in middle school classrooms usually reveal denser friendship networks, with on average four friendship nominations per person and a total of 80 ties per classroom (e.g., Sentse, Kiuru, Veenstra, & Salmivalli, 2014). It may be that this difference in network density stems from both the rapidly changing network environment in Dutch prisons – as compared to relatively stable classrooms – and prisoners’ difficulty with trust (Liebling & Arnold, 2012) which was hypothesized to hinder relationship formation. In addition, the time that prisoners can spend together in the unit is quite limited as compared to other network contexts; in the Netherlands, time on the unit outside of one’s cell is limited to hours of leisure and yard time. Moreover, the average sentence length in Dutch prison is short and may cause prisoners to be less inclined to invest in prison peer relations (Kreager, Palmen, et al., 2016). The Prison Inmate Network Study (PINS: Kreager et al., 2017; Schaefer et al., 2017) set in an American state penitentiary, found the average number of prison peer nominations to be similar to adolescent school-based networks (i.e., four social ties per person). A major difference to our study is that the PINS prison unit consisted of over 200 prisoners with average time spent on the unit of 1.4 years, whereas the sampled Dutch prison units consisted of, on average, 26 prisoners with average time spent on the unit of 7.5 months. With a larger network of people to choose from, and prisoners held for longer periods of time, it is likely that more social ties come to develop. Moreover, as was found by Kreager, Palmen, et al. (2016), having few prison ties may be adaptive for prisoners with short sentences, as there is less incentive to embed oneself in the prison social structure given impending release and community reentry. Nonetheless, as is apparent in Figure 1, few prisoners in the Dutch prison units had no social ties at all (so-called “isolates”). We can conclude from this that the universal need to belong (Baumeister & Leary, 1995) contributes to prisoners seeking to establish at least one social relationship with their fellow prisoners while incarcerated.

Prisoners’ relationship preferences

Second, with a closer look at *between whom* social ties were most likely to occur in the prison networks, we found strong evidence for homophily, indicating that similarity fosters tie formation (McPherson et al., 2001). The phenomenon of homophily found in many types of networks is explained by the assumption that similarity on important attributes eases communication, makes people understand each other better, and increases one’s predictability and trustworthiness (McPherson et al., 2001) – the latter being particularly important for friendships in the prison context (Bronson, 2008). Demographic factors that stratify society were also important contributors to clustering in prisoners’ social networks in the current study, including age, ethnicity, and religion. Notably, relative to other attributes we observed particularly strong homophily among Muslims, compared to other or no religion. This effect was also visible in the PINS study (Schaefer et al., 2017), but one should also note that Muslims in

the American prison context are primarily of African-American descent and converted to that religion during their incarceration. In the European context, the network segregation of Muslims within prisons is likely exacerbated by their predominantly Middle Eastern descent (Liebling & Arnold, 2012). The political context in the Netherlands may also contribute to this finding, since some politicians have made explicit anti-Muslim statements over the past few years. Young male Muslims in The Netherlands face issues regarding respect and police profiling that are likely similar to those faced by young male African-Americans in the US. Given the design of our study, though, it is unclear whether Muslims actively seek out one another (indicating a preference) or whether they are rejected or avoided by other prisoners and have no other choice than to connect with other Muslims (indicating default selection). The former process could occur for practical reasons, such as shared beliefs, culture, and religious practices. In contrast, if it were true that they are avoided or rejected by other prisoners, this may be due to the aforementioned mistrust, fear, and stereotyping towards Muslims. Policy implications cannot be made without knowing which of the reasons for strong religious homophily are accurate, for which more research on this topic is needed.

Next, in contrast to most American network studies (e.g., Goodreau et al., 2009), including PINS, we did not find strong racial or ethnic clustering. In the Netherlands, researchers commonly use ethnicity instead of race in their questionnaires. Moreover, in the current study our indicator of ethnicity was based on country of birth, which does not necessarily indicate ethnic heritage (country of birth of the parents). The lack of significant homophily on ethnicity in our network study may thus be the result of our measure (being born in the Netherlands versus elsewhere) that is less visible or notable for prisoners as compared to race or other measures of ethnicity. Yet, even in the American prison network study there was no strong clustering on race, or at least less strong than was predicted based on prior (prison) research (Schaefer et al., 2017).

Instead, Schaefer et al. (2017) found that the so-called “old heads” – those who were older and served the longest prison sentences – were important central persons in the unit and held several clusters in the network together (see also Kreager et al., 2017). We argued that due to relatively short sentences and smaller prison units in Dutch prison, such an “old head” system should be less likely as compared to the United States. In line with our hypotheses we found that prisoners who were older or who had spent more time in prison or on the unit were not more central in the network and thus not more likely to receive or send nominations than others. Moreover, none of our included socio-demographic factors were related to centrality in the network, suggesting no clear hierarchy. This finding highlights important differences between the American and Dutch prison context. Apparently, being an “old head” does not necessarily indicate status or popularity in Dutch prison, if one could speak of “old heads” at all. Although we did not find any sociality or popularity effects, we did find homophily effects for age, unit tenure, and prison tenure. Thus, instead of being central in the network, the old heads tend to cluster together in Dutch prison. Importantly, an absence of a clear group structure and hierarchy also reduces organized resistance and the necessity for prison groups associated with violence or a prison informal economy.

Strengths and limitations

Although the current study is one of the first to apply a social network perspective to the context of prison to better understand network structure and peer integration in prison, the study is not without limitations. First, we only studied prison regime units and it is unclear whether similar network structures exist in different regimes. It can be argued that, for example, among pre-trial detainees (who are not yet convicted) different network structures exist given the much higher turnover rates and because they spend most of their time on cell, both factors limiting relationship formation. Similarly, prisoners in minimum security units will have more opportunities to maintain their social ties outside prison and may be less inclined to turn to fellow inmates for their need to belong.

Another generalization issue stems from the fact that our study included only male prisoners. It is unclear whether similar network structures and effects will be found among female prisoners. The few previous qualitative prison studies indicate that females differ from males in how they experience and deal with imprisonment, including their relations with fellow prisoners (e.g., Krabill & Aday, 2007; Lindquist, 2000; Severance, 2005; Wulf-Ludden, 2013). Also, from studies conducted both inside and outside prison, it is clear that the content and needs of friendships of males and females are quite different (Hall, 2011). All in all, replication of this network study to different prison regimes and populations is warranted.

Next, due to the cross-sectional design of our study we can only provide a snapshot of prisoners' social networks and were unable to elucidate dynamic network processes. Disentangling network selection and influence processes would require a longitudinal design, in which changes in social ties can be studied – such as relationship dissolution and formation, and prisoners entering or leaving the network – and to link these changes to prisoners' characteristics and overall network characteristics. A longitudinal network study with repeated measures would provide more information on network *processes* that were only assumed in the current study. In addition, more factors than the socio-demographic characteristics included in this study may affect relationship formation, including mental health, misconduct, and substance abuse. Future studies should include a larger variety of factors to predict in-prison social networks.

Last, most network effects that we reported varied to some extent between the nine prison units. Although estimates varied only in magnitude and not in direction, between-unit differences may exist and unobserved covariates may explain these differences. The limited number of prison units and lack of variation in prison regime prohibited a between-unit comparison, but future studies may do well to survey a larger number of prison contexts and include unit-level variables, such as type of regime, security level, behavior and attitudes of prison staff towards prisoners, and prison layout.

Notwithstanding these limitations, the current study advances our understanding of prisoners' relationships by applying a sociological method that is still new to the context of prison. The network approach allows direct comparison of prisoners' social organization between the Netherlands and other countries using common (socio)metrics. Our results show that prisoners are able to get along well with at least some other prisoners and that the web of relationships in prison units, albeit fewer in number, largely resemble friendship networks in other contexts, including clustering on

important socio-demographic factors such as age, religion, and criminal experience (time spent in prison or on the unit). Knowledge on these social structures and network processes are also of practical relevance. A social network approach generates visual representations of unit social structure (such as [Figures 1](#) and [2](#)) that is immediately understood by prison staff and administrators. As network studies in other contexts have proven (Adams & Schaefer, 2016; Valente, 2012; Zhang, Shoham, Tesdahl, & Gesell, 2015), it can also offer tools for prison policy. For example, an implication of our study showing absence of an “old head” system, is that there are less obvious inmate leaders for prison staff to co-opt for increased prison stability (Sykes, 1958). But as said earlier, an absence of a clear hierarchy also reduces organized resistance and the necessity for prison groups associated with violence or a prison informal economy. More generally, then, social network analyses can test the effects of, for example, unit transfer, segregation of prisoners, or shared cell assignment on a multitude of unit- and individual-level outcomes. Knowing what drives network formation in prison and prisoners’ positions within these structures, can help determine unit composition and the stimulation of positive peer relations in prison, which will ultimately benefit the prisoners and the overall prison climate.

Disclosure statement

The authors have no conflicts of interest to declare.

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