Investigating the effect of Locus of Control on health promoting behaviours and recovery in Schizophrenia: A Systematic review and meta-analysis

Introduction (2844/2500)

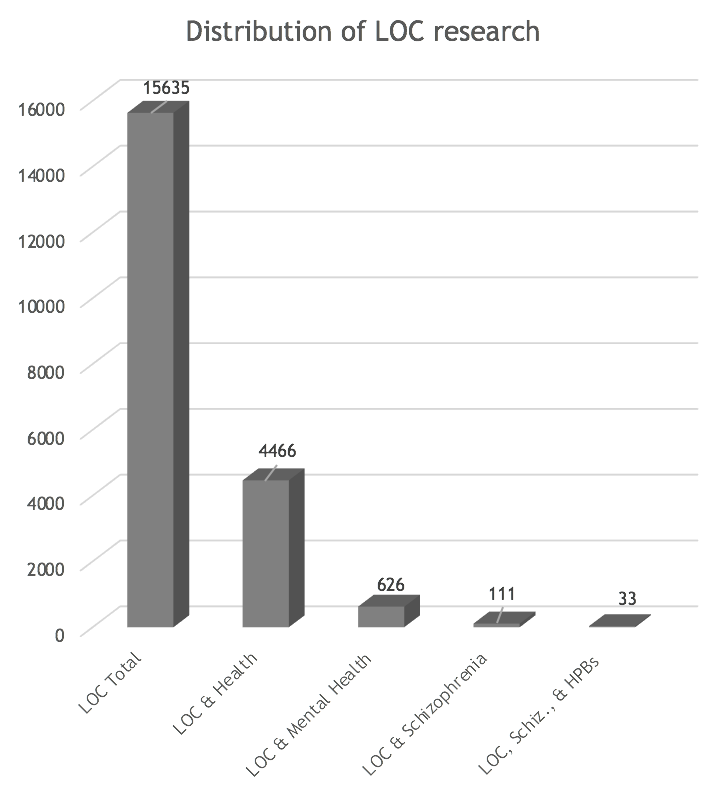
Schizophrenia is a complex illness involving a range of behavioural, cognitive, and emotional symptoms, including but not limited to: delusions, hallucinations, disorganised cognition (speech), and impairments in psychosocial functioning (American Psychiatric Association and American Psychiatric Association, 2013). The most recent figures show that there are approximately 220,000 people being treated for schizophrenia in the UK (NICE, 2014). Of those who receive a diagnosis for schizophrenia, only 25% fully recover (Fuller, 2006).

Not only are recovery rates low, but what constitutes recovery (Morin & Frank, 2017; Resnick et al., 2005; Rossi et al., 2017), or the factors that influence recovery are also elusive  (Eisner et al., 2013; Silverstein & Bellack, 2008). Writing in 2008 the then Chair of the APA’s Task Force on Serious Mental Illness stated that although recovery is widely discussed in schizophrenia, the field lack “scientific basis” and that “factors that facilitate recovery processes” need to be identified (Silverstein & Bellack, 2008, p.1108). This review will seek to assess whether Locus of Control (LOC) might prove to be a valuable factor.

Locus of Control (LoC) is the degree to which an individual ascribes events, and the outcome of events to themselves, or to external forces - either chance or powerful others (Rotter, 1966). Since first being described by Julian Rotter in 1966, the LoC construct has been the focus of continued refinement and application to various areas of research (Rotter, 1990; Wallston, 2005). In particular, LOC has been studied as a “domain-specific characteristic”, for example in terms of one’s LOC in the domain of health behaviours (Ammirati & Nowicki, 2015). Health promoting behaviours (HPBs), which are the focus of this study, are those behaviours shown to have an association with decreased morbidity and mortality (Savador-Carulla et al., 2013; Sobal et al, 1985).

One of the main uses of LOC in this domain is as a “predictor of health behaviour” (Wallston, 2005, p.628). And in fact, whether predicting the use of emergency or inpatient hospital services (Mautner et al, 2017), physical activity in cardiovascular patients (Mercer et al., 2018, Grisolía et al, 2015), or health behaviour generally (Berglund et al., 2014; Cohen & Azaiza 2007, Janowski et al., 2013), LoC has become one of the most widely used predictors of health-related behaviours (Kretchy et al. 2014; Rice 2012).

Despite being a mainstay in understanding behaviour in health generally, the same cannot be said for mental health, and more specifically schizophrenia. The search results for the literature review for this study illustrates how LoC has been investigated since it was described decades ago (see fig.1). Out of the more than 15,000 studies with LoC in their title or abstract, almost 4,500 also mentioned health, the number drops of significantly when mental health replaces health coming in at 626, and drops to 111 when schizophrenia replaces mental health, and 33 when various terms denoting health promoting behaviours are added -see the methods section for how the various terms were identified.



*Figure 1:* Data showing distribution of LoC research 1976-2018.

The LoC construct:

Those with an internal locus of control view themselves as the prime source of influence over events in their lives; this sense of agency leads to greater self-efficacy and responsibility (Ammirati & Nowicki, 2015; Wallston et al. 1978). Externality is subdivided into powerful others and chance. Those with a greater sense of event outcomes being down to the will of powerful others are more likely to be accepting of that power, and in a sense place themselves in that power’s control in a given context (Hoffmann, 2000; Myers, 1997). Those who don’t believe in any underlying guiding force, believe that events are down to chance which results in a more fatalistic outlook (Bailis et al., 2010; Jaeger et al., 2014).

It is important to note that this ascribing is not just to past events but future events also, what Rotter terms *expectancies* (Rotter, 1966; 1975; 1990). What’s more, Rotter found that when externally oriented individuals could be shown to have taken control and succeeded in shaping events, they would maintain that it was “a matter of luck”, and no indicator of future performance (Rotter, 1990). This phenomenon and the development of externality in general, was “essentially defensive” in nature (Rotter, 1975, p.64); later research by Showers (1988) and Fernandez and Bermudez (2000) on *defensive pessimism* support this assertion (Fernandez & Bermudez, 2000; Showers, 1988). Rotter proposes that insisting on the role of powerful others is “blame projecting” (Rotter, 1975, p.64); a longitudinal study by Bailis et al. found that individuals became fatalistic over time, deriving from a “defensive denial” that one’s health would continue to change significantly (Bailis et al., 2010). In both cases, there is a denial of responsibility underpinning the importance of self-determination in one’s health behaviours, a theme which will be examined and returned to later in the discussion when discussing attitudes to treatment.

Despite being “relatively stable”, individuals expectancies could change over time as a result of reinforcement (Rotter, 1990, p.490). The scale itself acts along a continuum, with internal and external being orthogonal in nature (Rotter, 1990; Wallston, 2005; Wallston et al., 1978). Research shows that the course of schizophrenia generally is very much a function of one’s relationship to their illness (Hoffman et al. 2000; Hoffman & Kupper, 2002; Strauss, 1989). If clinicians were afforded a framework based on LOC for nurturing a positive relationship to their illness with accompanying health-promoting behaviours, it might provide a valuable tool for influencing disease course and outcome.

Health promoting behaviours:

Health promoting behaviours are a variety of human behaviours that either promote health and longevity, decrease the risk of early mortality and morbidity (Ping et al., 2018; Savador-Carulla et al., 2012; Sousa et al., 2015; Taymoori et al., 2012). HPBs include the presence of positive behaviours -appropriate sleep schedule, exercise, healthy diet etc., as well as the absence of negative ones -moderating substance use, decreasing stressors etc. (Savador-Carulla et al., 2013; Sobal et al, 1985). It is important to note that with health-promoting behaviours it might not be as much a case of professionals identifying their presence or absence, but more about understanding an individual’s unique recovery or health orientation, their relationship to their illness (Greer, 2013; Snethen 2011). It is here where the effect of LoC might possibly take place; in one’s relationship to their illness, this will be returned to in the discussion with regards LoC, health responsibility, and the potential for clinical intervention (Hoffmann et al., 2000; Hoffman and Kupper, 2002).

In terms of a taxonomy of HPBs, whilst there are many different identified behaviours, common dimensions include health responsibility, nutrition, social support, stress management/cognition, and physical activity (Ping et al., 2018; Savador-Carulla et al., 2012; Sousa et al., 2015; Taymoori et al., 2012). Although these dimensions are by definition different in nature and represent behaviours even more wide-ranging, an illness like schizophrenia impacts an individual’s global functioning and as such is influenced by, and indeed influences, all  dimensions (Hosseini & Karkhaneh Yousefi, 2011; Snethen 2010). If there were found to be an underlying construct significantly impacting them all, that was itself malleable, it would offer a highly valuable avenue of intervention.

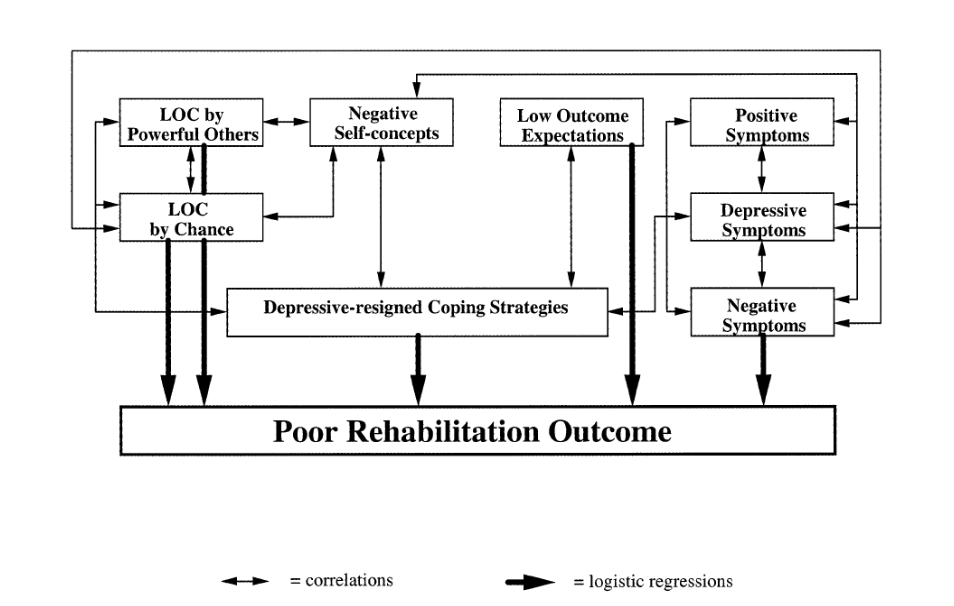
In terms of the relationship between HPBs and LoC, there has been significant research supporting the link between LoC and HPBs generally amongst various population groups (Açıkgöz Çepni & Kitiş, 2017; Cohen & Azaiza, 2007; Hosseini et al., 2016; Pourhoseinzadeh et al., 2017). Research has also been carried out linking LoC and specific health behaviours for example: diet, physical exercise, and substance use (Cheng et al., 2016). Domain specificity has also argued for in HPBs with the majority of research looking at the relationship between LoC and HPBs within specific disease groups (Wallhagen & Brod, 1994; Wallston, 2005). When investigating HPBs, the tools and the understandings that inform those tools are also often “directed at specific diseases” or at least used in analogous settings (Savador-Carulla et al., 2013, p.1964), this is due to findings showing certain behaviours are more crucial in certain contexts (Abraham & Michie, 2008).

LoC, HBPs and schizophrenia: a literature review

In the context of schizophrenia it has also been argued that having a disease-specific understanding would be of some value (Harrow et al., 2009; Hoffmann et al., 2000; Hoffman and Kupper, 2002; Kim, 2005; Surmann et al., 2017; Talesh, 2002; Thakral, et al., 2014; Wallhagen & Brod, 1994). Potential areas of interest included LoC’s correlation with “severity and chronicity” in schizophrenia (Harrow et al., 2009, p.2). Continuing the theme of relationship, Hoffmann et al., 2000 discussed the need to illuminate the mechanisms that influence not just the disorder’s processes, but also the “interaction between the person and the disorder” (Hoffmann et al., 2000, p.147). Having identified LoC as a potentially important component of this interaction, Hoffmann and Kupper (2002) followed up with research looking at *facilitators* of rehabilitation in schizophrenia wherein internal LoC was identified as a key element in individuals believing they could “influence their own fate” making them more likely to engage in rehabilitation aiding activities, what might otherwise be described as HPBs (Hoffmann and Kupper, 2002, p.295). Others took a different line of inquiry in looking at rehabilitation and investigating the role of LoC in influencing specific therapies (Kim, 2005), or indeed the therapeutic relationship itself (Combes and Feral, 2011; Jaeger et al, 2014).

Others searching for facilitators of recovery in schizophrenia turned to the relationship between HPBs and LOC: for example, Bender (1995) investigating *cognition* looked at LoC and perceived self-efficacy and hardiness and their correlation to recovery in terms of the level of function following various durations and numbers of hospitalisation (Bender, 1995). One of the strengths of this early research was that by having different periods of hospitalisation, the research was able to look at the impact of chronicity on LoC and adaptive functioning. This offered an explanation for non-significant findings resulting from participants with the same level of internal LoC but different levels of chronicity. An explanation for this was that, “it may be frustrating, not adaptive, to try to control the outcomes of a process… which cannot be internally controlled”, the result being one’s ceasing to try to adapt (Bender, 1995, p.105, citing Weaver, 1994, p.93).

This insight would later be supported by research by Hoffmann et al. into hopelessness, adaptive functioning, and rehabilitation (Hoffmann et al., 2000; Hoffmann and Kupper, 2002). Their research offers a very strong conceptual framework (see fig.x) demonstrating the various paths that may lead to “reciprocal escalation and stagnation” and subsequent poor rehabilitation outcome (Hoffmann et al., 2000, p.155). Here Bender’s internally oriented but less adaptive individual finds parallels in the ‘Depressive-resigned Coping Strategy’, an outcome perhaps of Miller’s “mutually reinforcing biological and social processes” mentioned previously (Miller et al., 2001, p.197). Whilst the depressive-resigned coping strategy leads to poor rehabilitation outcome, resignation may also lead one to internalise an external orientation and allowing others to take control (Hoffmann et al., 2000, p.156), this has implications for medication adherence another area of investigation.



*Figure 2:* Contributing factors to hopelessness and poor rehabilitation outcome according to our findings=correlations=logistic regression (Source: Hoffmann et al., 2000, p.155).

Medication adherence is another widely studied area of health behaviour. Myers 1997 researching LoC and medication ‘compliers versus noncompliers’ found that whilst internal and chance LoC did not differ significantly, those with a powerful others orientation were significantly more likely to adhere to the clinicians' medication recommendations (Myers, 1997). Further supporting the resignation explanation, the study found that age was a factor related to medication compliance, with older individuals being more compliant. Showing a dexterity of investigation the study controlled for ‘insight’ resulting from age as a moderator using an ITAQ Scale and found no significant correlation, instead offering the possibility that individuals had “gotten more ‘burnt out’ as they aged and their compliance is an expression of their decreased defiance in the face of their mental condition” (Myers, 1997, p. 38).

A study by Combes and Feral (2011) they described as “the first exploring belief in health control and drug compliance” also investigated individuals beliefs regarding health and control (Combes and Feral, 2011, p.7). Results contradict those of Myers, with ‘insight’ found to be a “confounding factor” (Combes and Feral, 2011, p.6). What’s more, whilst powerful others was again found to have a significant positive correlation with adherence, so was an internal orientation (Combes and Feral, 2011). An explanation given for the internal significance was its connection to insight. Whereas Myers found no significant correlation with insight, as mentioned Combes and Feral found insight to be a factor. They observed that whilst some individuals can have a “pretty good” understanding of the challenges in their lives, they may fail to attribute it these to their illness; internality was demonstrated to be a factor in one’s correctly attributing symptoms to their pathology (Combes and Feral, 2011, p.6). Contradictions in any sample of studies are of course to be expected and will be returned to in the discussion.

A criticism of Combes and Feral but one which is indicative of the nascent nature of the field is their insistence at various points that their research is the first of its kind. The only meaningful difference between Combes and Feral and Myers was their use of scales, the former using a *Scale to assess Unawareness of Mental Disorder* (SUMD) and the later using an *Insight and Treatment Attitudes Questionnaire* (ITAQ), there is enough overlap in what they measure (Sanz et al., 1998) to make this minor difference insufficient grounds for the assertion *first of its kind*. Combes and Feral also refer to a mental health locus of control scale, but they do so erringly, referring to Form C of Wallston’s Multidimensional Health Locus of Control Scales as the Multidimensional Mental Health Locus of Control (MHLC) scale which is an obscure and completely different scale devised by Levenson 1973 (Levenson, 1973). Whilst these two issues might just demonstrate a lack of rigour on the part of the researchers, they may also reflect the difficulty building up a cohesive body knowledge in a field that lacks a strong scientific basis (Silverstein & Bellack, 2008).

All of the research detailed here and the majority found for the entire study employed correlational study design. As such, none of the studies made any claims of causation. Mediation, however, was often referred to, with various, sometimes complex, regression analyses used to investigate. However, according to Fritz and MacKinnon none of the sample sizes detailed in the meta-analysis or meta-synthesis afforded the power necessary to avoid the various associated errors (Fritz and MacKinnon, 2007). Whilst many insights are offered into potential mechanisms for the effect of LoC on HPBs robust data borne from large sample sizes offering mediation and causation is a significant gap in the literature.

The purpose of this research is assess LOC as factor influencing recovery in schizophrenia through its effect on HPBs. More broadly the review will aim to is to assess how current research might inform clinical interventions, and how future research avenues and methodologies might fill identified gaps in the literature.

To this end this research will seek to answer the following questions:

1. Is there consistency of effect size and direction of effect within the sampled research?
2. What explanations are being presented to explain the effect of LoC on health-promoting behaviours in schizophrenia?
3. When contradictions are found, are there consistencies, and what insights can be gained from unpacking them?
4. What gaps exist in the literature, what are the underlying reasons, and what are some potential research avenues and methodologies for filling these gaps?

Hypothesis:

1. An internal LOC orientation will be positively correlated with the presence of HPBs.
   1. An external LOC (powerful others) will be negatively correlated with the presence of HPBs.
   2. An external LOC (chance) will be negatively correlated with the presence of HPBs.
2. The null hypothesis is that there will be no correlation between LOC and HPBs.

Drawing on PRIMA Protocol’s PICOS format (Liberati et al., 2009), all studies that return a Pearson’s r statistic or data that can be converted into an r statistic will be included. Cross-sectional and longitudinal studies will be included. Both observational and interventional studies will be eligible for inclusion. All studies with participants from the general adult population will be included (18 years+).

Studies with mixed groups of whatever make-up will be included if it is possible to separate out the data for the general adult population. Of interest are interventions that specifically seek to shift one's position on a given locus of control scale as an intervention into the progression of their schizophrenia, and all correlational studies investigating correlations between LoC and any HPB. Outcomes under investigation include any outcomes related to the presence or absence of HPBs, a shift in LoC with a view to influencing the presence or absence of HPBs, or change in schizophrenia diagnosis or prognosis resultant from the interaction of LoC and HPBs.  There will be no settings restrictions, however, in-patient versus out-patient, and preclinical versus clinical settings will be addressed in the discussion.

Methods (873/750)

The 2009 PRISMA Protocol (Preferred Reporting Items for Systematic reviews and Meta-Analyses) informed the search, selection, and critical assessment criteria for this review (Liberati et al., 2009).

Search strategy and data sources

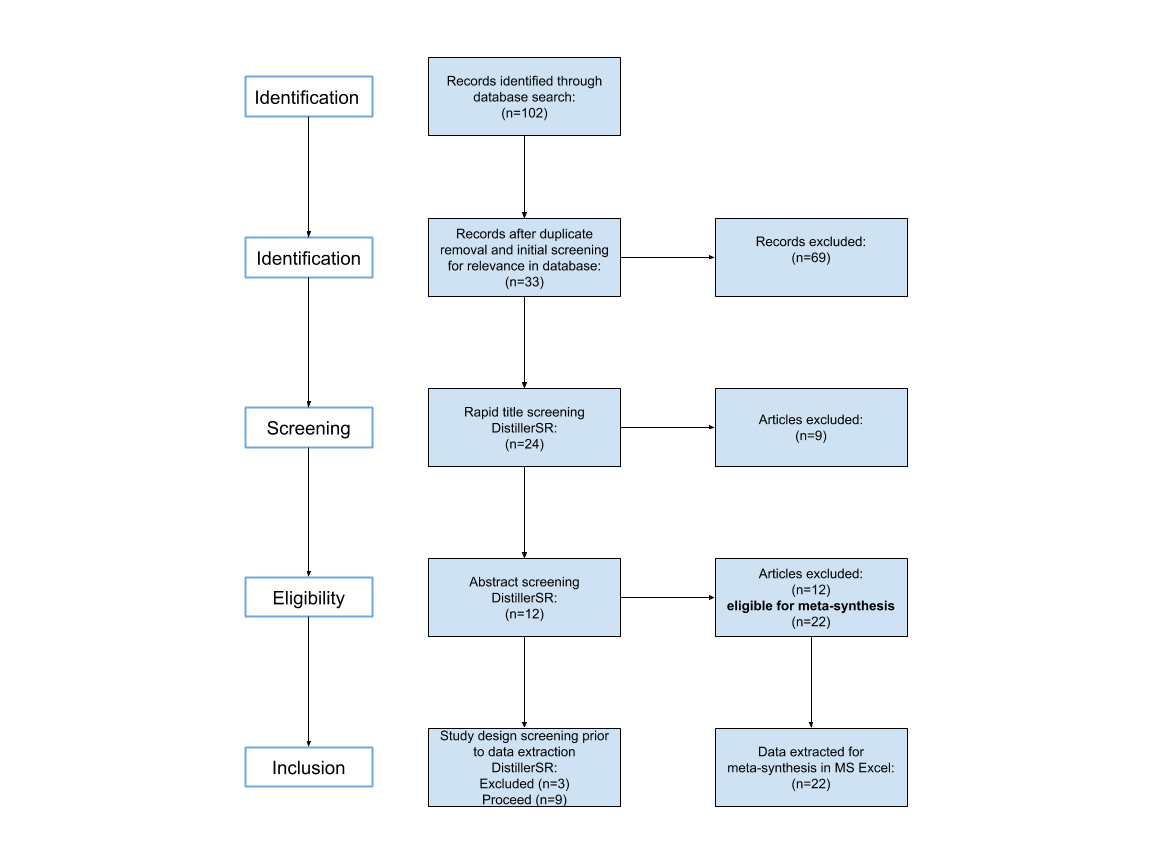
In accordance with Lemeshow et al. 2005 who argue that meta-analyses of observational studies need to include at least three databases, and Lam and McDiarmid who found that general trends in the number of databases employed have seen a rise from an average 1.62 in 1994 to 3.73 in 2014, and given the lack of studies generally in this subject area, a total of five electronic databases were searched: MEDLINE, PubMed, PsycINFO, PsycArticles, and Science Direct (Lam and McDiarmid, 2016; Lemeshow et al., 2005.

Quantitative studies were sought. No study design were limits imposed at this initial stage. A patient diagnosis of schizophrenia according to DSM-III, DSM-IV, and DSM-5 was used. The DSM-III saw a clear paradigm shift in the classification of mental illness from previous iterations (Mayes & Horwitz, 2005; Kawa & Giordano, 2012), and whilst DSM-5 has dropped the multiaxial system that made DSM-III a “revolution” (Kawa & Giordano, 2012), it is not appreciably different in its classification (Regier et al., 2013) with 98% of those receiving a diagnosis under DSM-IV maintaining their diagnosis under DSM-5 (Tandon et al., 2013). A date restriction of 1975 (when the DSM-III was first published) to present was applied. PROSPERO was also searched for systematic reviews on LoC in schizophrenia. No grey literature was searched. The box below details appropriate search terms and filters for the different databases:

|  |  |
| --- | --- |
| **Database Name** | **Search term** |
| PsycINFO; PsycARTICLES; MEDLINE  Using ebscohost | TI "locus of control" AND AB "locus of control" AND TI schizophrenia AND AB schizophrenia AND TI relevant HPB AND AB relevant HPB  1975-present |
| ScienceDirect | TITLE-ABSTR-KEY(schizophrenia) and TITLE-ABSTR-KEY("locus of control") and TITLE-ABSTR-KEY(relevant HPB)  1975-present |
| PubMed | schizophrenia[Title/Abstract] AND "locus of control"[Title/Abstract] AND relevant HPB  1975-present |
| PROSPERO | “Locus of control” schizophrenia |
| Total | 102 |

*Figure 3:* Data showing search criteria and databases employed.

A total of 102 records were identified for inclusion in the review (see Box 1). 69 represented duplicates and irrelevant subject matter. Of the 33 articles that progressed to rapid title screening (see fig. x) using DistillerSR Online online software, 24 continued to the next stage. Following full-text screening assessed criteria including a diagnosis for schizophrenia or schizoaffective disorder, that the participants be aged 18+, the reporting of statistics, sufficient information to assess methodological quality etc., a total of 21 of the 24 were eligible for meta-synthesis, whilst 12 progressed for study design screening prior to meta-analysis. Study design screening addressed various aspects of the studies including purpose, sample size, within or between groups, attrition etc., 9 proceeded to meta-analysis (see Appendix x for DistillerSR screening forms).



*Figure 4:* Study flow diagram

Participants

For the meta-analysis, individuals with a diagnosis of schizophrenia or schizoaffective disorder and aged 18+ were included. For the meta-synthesis which focused more on explanations and insights, diagnostic criteria remained the same whilst studies with participants of adolescent age (n=1) were also included (ages 15-25).

Apparatus

DistillerSR online software - screening and bias/quality assessment. Microsoft Excel. R for Mac with accompanying script created by Quintana 2015 (R Core Team, 2018; Quintana 2015). Compute.es package for R (AC Del Re, 2014). Conversion tables for converting Spearman’s Rho to Pearson’s R (Gilpin, 1993; Strahan, 1982).

Coding and meta-analysis

Following screening using DistillerSR, the effect sizes from each of the 9 articles were coded according to the script (Quintana, 2005) with each LOC having its own group of effect sizes (see figures 5, 8, and 11). No effect size aggregation took place, when an aggregated effect size and a single HPB effect size were available, the aggregated score was taken as it contained the single effect size within. Where necessary, effect sizes were converted to *r* using compute.es (t-test) and conversion tables (Spearman rho). Where necessary effect sizes were flipped so that a positive *r* value indicated an increase presence HPBs. The meta-analysis was then carried out according to the script on each group testing each of the hypotheses separately.

Coding and meta-synthesis

Coding for the meta-synthesis was informed by PRISMA Protocol’s PICOS format and mined the following headings: Author, year, and the number of participants. Purpose, the purpose of the investigation/intervention as explained by the author(s). Population, detailing sample characteristics. Outcome, giving a brief account of the outcome and results described by the author(s). HPB investigated. Study design. Effect estimate. Conclusion, a brief account of the conclusion given by the author(s). Comments, detailing this author’s thoughts on the study and insights contained therein. Criticisms and limitations detailing this author’s and the study author’s criticisms and concerns. The meta-synthesis will be employed in the discussion section to give insights to the output from the meta-analysis, and also help answer the wider review questions detailed in the introduction.

Ethics

Ethical considerations for this research were informed by Cooper and Dent’s 2014 *Ethical Issues in the Conduct and Reporting of Meta-Analysis,* and Liberati et al.’s 2009 explanation and elaboration on reporting systematic reviews and meta-analyses (Cooper and Dent, 2014; Liberati, 2009). Use of secondary data was approved by the MMU ethics panel. Given that there is a good deal of paraphrasing and summarising there is a responsibility in the part of the author to do their utmost to remain as close to the original text in meaning and intent as possible. Given that this is a completely solo exercise it is important to be as transparent as possible in detailing the processes and procedures involved in the undertaking of this review.

Results (636/750)

Meta-analysis

LoC internal

Figure 5 offers an overview of the internal group of effects sizes.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Year** | **n** | **Mean age** | ***r*** | **HPB Measure** | **LOC Measure** |
| Chuang et al | 2016 | 56 | 43.6 | 0.5 | HPLP-11 | MHLC |
| Jaeger et al. | 2014 | 69 | 42.6 | -0.15 | MARS | MHLC |
| Modestin et al. | 2009 | 60 | 37 | 0.22 | ISOS | IPC |
| Surmann et al. | 2017 | 80 | 38.2 | 0.36 | ISMI | FKK |
| Myers | 1997 | 50 | 37 | 0.03 | ITAQ | MHLC |
| Combes & Feral | 2010 | 65 | 37.1 | 0.26 | MARS | MHLC |
| Retherford | 2005 | 19 | 46.5 | 0.55 | HBC | MHLC |
| Hoffmann et al. | 2000 | 46 | 27.6 | 0.33 | JankeScale | IPC |
| Hayley et al. | 2003 | 50 | 29.1 | 0.31 | DIA | MHLC |

*Figure 5:* Overview of study data for internal LOC

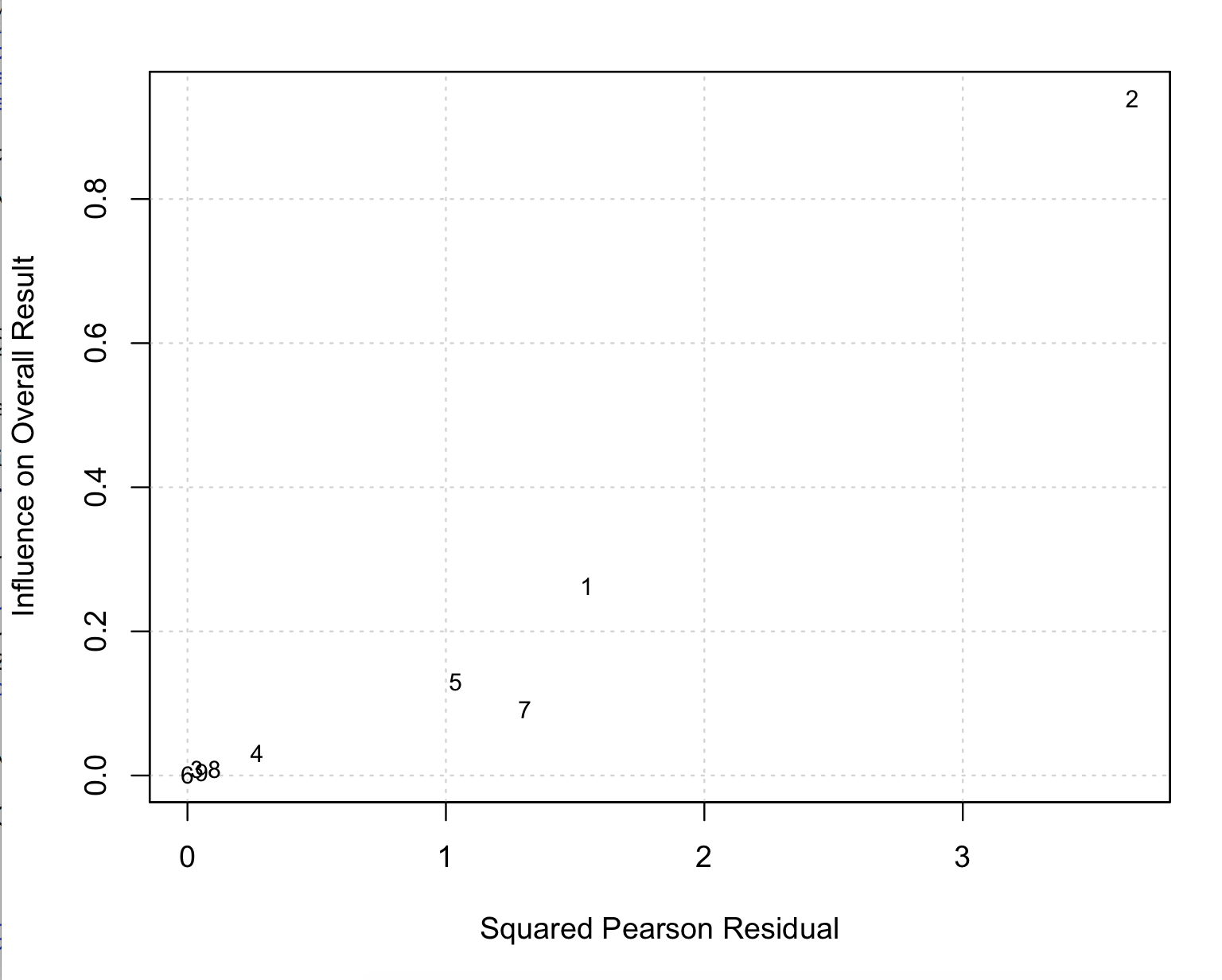
Hypothesis 1 stated that an internal LOC orientation would be positively correlated with the presence of HPBs. Analysis reveals a significant effect size of 0.27 (95% CI = 0.11, 0.42, p<0.001) indicating a “medium” to “large” positive effect (Cohen, 1988, p.80) of internal LOC on the presence of HPBs.

Cochran’s test for heterogeneity was not significant, *Q*(8) = 21.67, *p* = .006, indicating effects were not heterogeneous, however this does not indicate sample studies are homogenous (Higgins et al., 2003; Quintana, 2015). Further, the sample size here is bordering on the small side of 8 or less (Higgins and Thompson, 2002), and *Q* is prone to underestimating heterogeneity in small sample sizes (Higgins and Thompson, 2002, p. 1548). What’s more, aside from sample size, diversity in clinical and methodological approaches between studies are also likely cause of heterogeneity, making testing for heterogeneity less pressing than understanding the extent to which it affects the conclusions of the meta-analysis. As such, *I*2 statistic, which is not dependent sample size was employed (Higgins and Thompson, 2002; Higgins et al., 2003; Quintana, 2015).

*I*2 is 62.54% (95% CI; 17.98, 90.28) indicating moderate to high variance showing that most of the variability is due to “heterogeneity rather than chance” (Higgins et al., 2003). The Baujat plot in figure x shows studies that excessively influence the overall result and heterogeneity with one study in the top right quadrant clearly makes the biggest contribution (Quintana, 2015). Potential causes of study heterogeneity and the impact on the results of the meta-analysis will be returned to in the discussion.

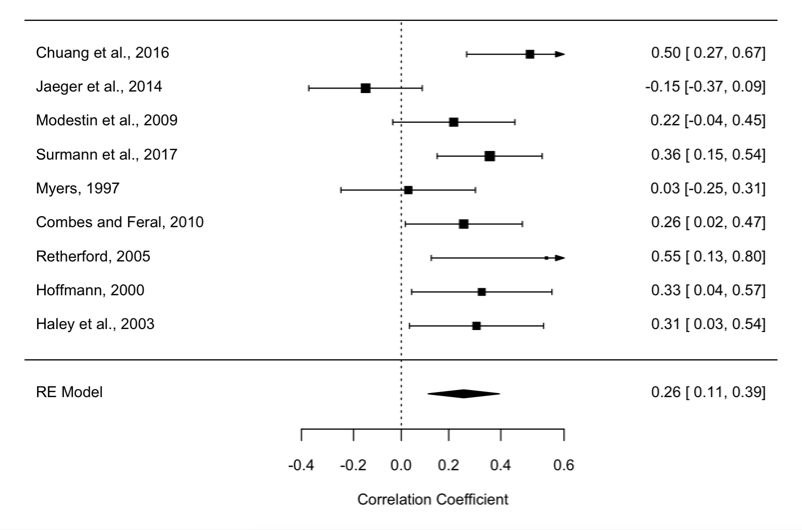
In keeping with the high *I*2 statistic, the forest plot illustrated in figure x shows a sample of heterogeneous studies with similar sized confidence intervals although two have been trimmed as shown by the arrows. Trimming mean confidence limits offers a more robust location estimation (Fields et al., 2012; Heckert and Filliben, 2003). One study left of the dotted line (the largest influencer in the Baujat plot above) represents internal LOC having a negative correlation with HPBs and one near the line shows almost no effect. Aside from one (Retherford,2005) there is a some consistency is the size of the squares indicating impact on the summary effect size (Quintana, 2015). The diamond at the bottom representing population effect based on all studies is well to the right of the vertical dotted line indicating with at least 95% certainty the null hypothesis can be rejected (Sedgwick, 2012).

The funnel plot (figure 7) shows some degree of symmetry indicating a lack of publication bias (Field, 2013). Consistent with this data, neither Egger's regression test (p = 0.22) or the Rank correlation test (p = 0.34) were statistically significant also indicating a lack of evidence for publication bias (Quintana, 2015).

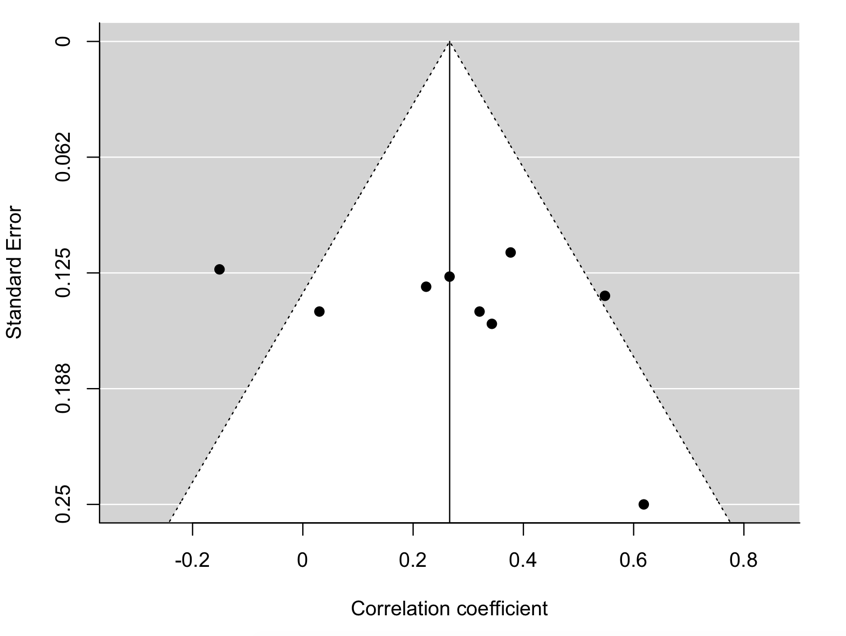


*Figure 3:* Baujat plot to identify studies contributing to heterogeneity. Each study is represented by a study id number. Studies located in the top right quadrant have both a greater influence on the overall result and contribute most to study heterogeneity.

        Author(s), Year           Correlation [95% CI]



*Figure 6:* Forest plot internal LOC.



*Figure 7:* Funnel plot of internal LOC.

LoC powerful others

Figure 8 offers an overview of the external powerful group of effect sizes.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Year** | **n** | **Mean age** | ***r*** | **HPB Measure** | **LoC Measure** |
| Chuang et al | 2016 | 56 | 43.6 | 0.50 | HPLP-11 | MHLC |
| Jaeger et al. | 2014 | 69 | 42.6 | 0.28 | MARS | MHLC |
| Modestin et al. | 2009 | 60 | 37 | -0.33 | ISOS | IPC |
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| Myers | 1997 | 50 | 37 | 0.32 | ITAQ | MHLC |
| Combes & Feral | 2010 | 65 | 37.1 | 0.28 | MARS | MHLC |
| Retherford | 2005 | 19 | 46.5 | 0.44 | HBC | MHLC |
| Hoffmann et al. | 2000 | 46 | 27.6 | 0.15 | JankeScale | IPC |
| Hayley et al. | 2003 | 50 | 29.1 | 0.35 | DIA | MHLC |

*Table 8:* Overview of study data for internal LOC

Hypothesis 2.a stated that an external powerful others LOC orientation would be negatively correlated with the presence of HPBs. Analysis reveals a non-significant effect size of 0.17 (95% CI = 0.05, 0.39, p<0.001) indicating a “small” positive effect (Cohen, 1988, p.79) of external powerful others LOC on the presence of HPBs.

Cochran’s test for heterogeneity was significant Q(8) = 48.74, p = .0001 and *I*2 was 82.07% (95% CI; 17.98, 90.28) indicating high variance (Higgins et al., 2003). The Baujat plot in figure x show two studies in the top right quadrant clearly make the biggest contributions. Again, potential causes of heterogeneity between studies and the impact on the results of the meta-analysis will be discussed in the discussion. Again, the forest plot illustrated in figure x shows a sample of heterogeneous studies with differing size confidence intervals of which three have been trimmed. Two study left of the dotted line (the two largest influencers in the Baujat plot above) represent external powerful others LOC having a negative correlation with HPBs. Again aside from Retherford, 2005 there is a some consistency is the size of the squares indicating impact on the summary effect size. The diamond at the bottom straddles  vertical dotted line (albeit more to the right) indicating the null hypothesis cannot be rejected (Sedgwick, 2012).

The funnel plot (figure 7) shows some degree asymmetry indicating the potential of publication bias (Field, 2013). However, neither Egger's regression test (p = 0.20) or the Rank correlation test (p = 0.34) were statistically significant also indicating a lack of evidence for publication bias (Quintana, 2015). Publication biases and inconsistencies will be returned to in the discussion.

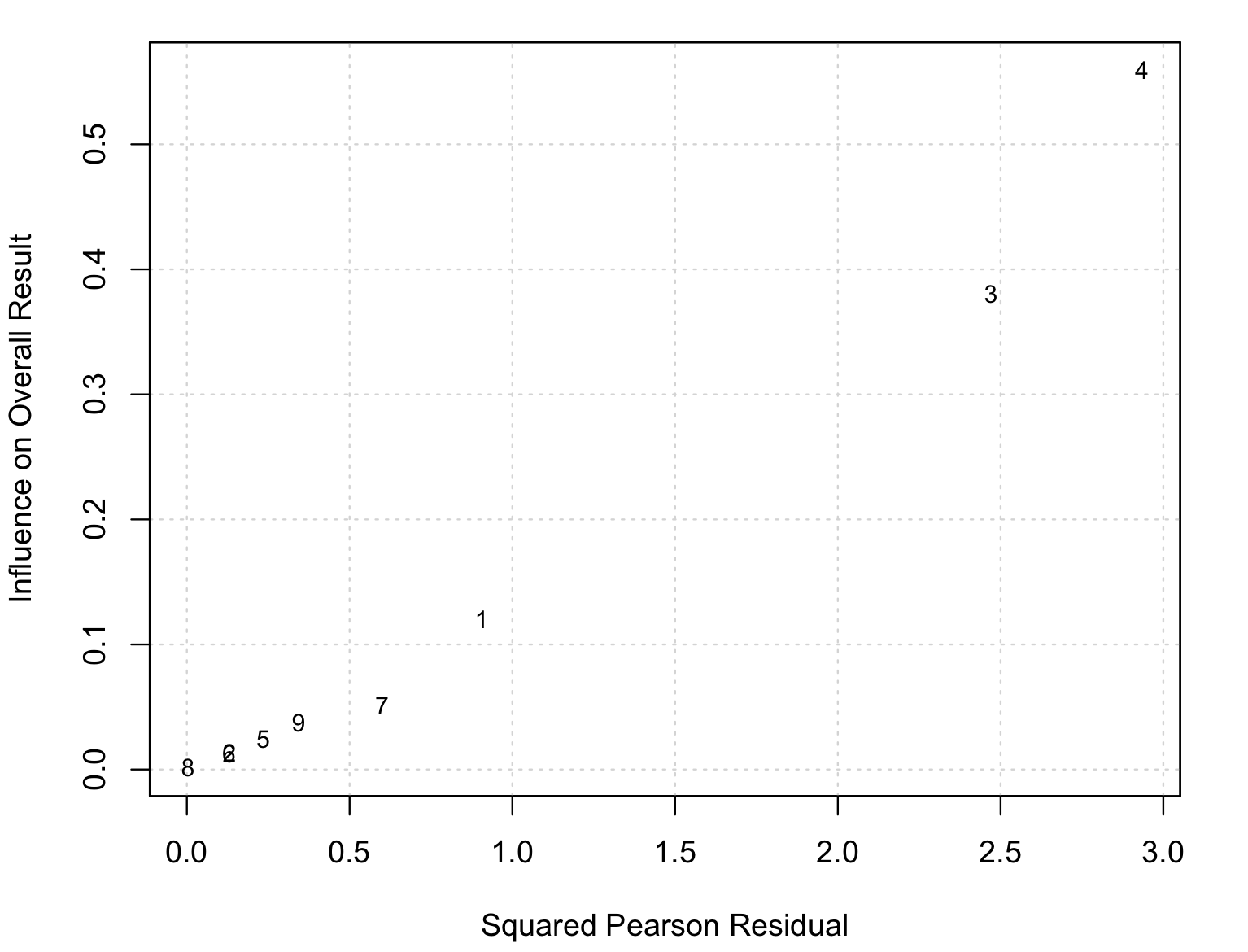
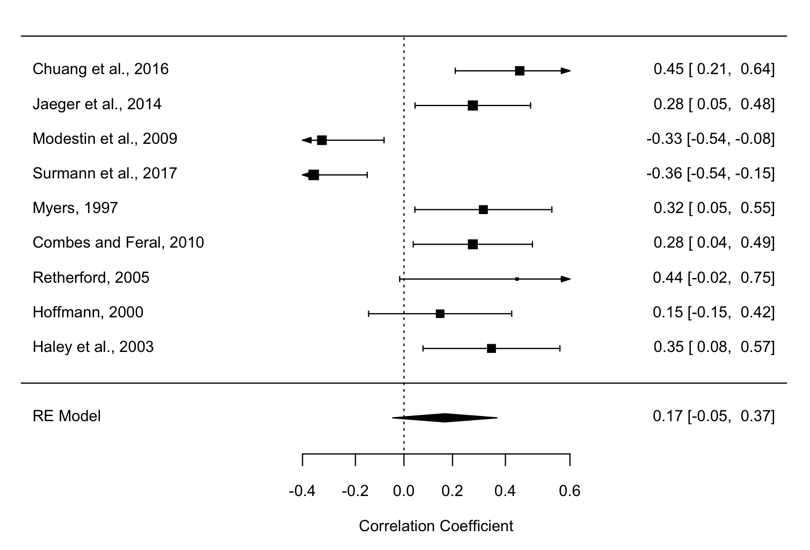
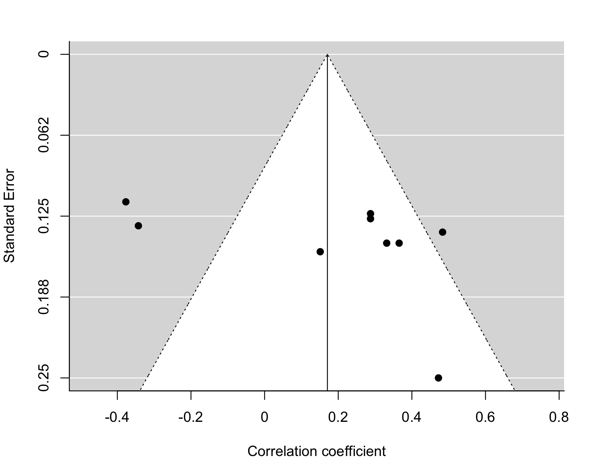


Figure 3: Baujat plot to identify studies contributing to heterogeneity. Each study is represented by a study id number. Studies located in the top right quadrant have both a greater influence on the overall result and contribute most to study heterogeneity.

        Author(s), Year           Correlation [95% CI]



*Figure 9:* Forest plot of powerful others.



*Figure 10:* Funnel plot of powerful others.

LoC chance

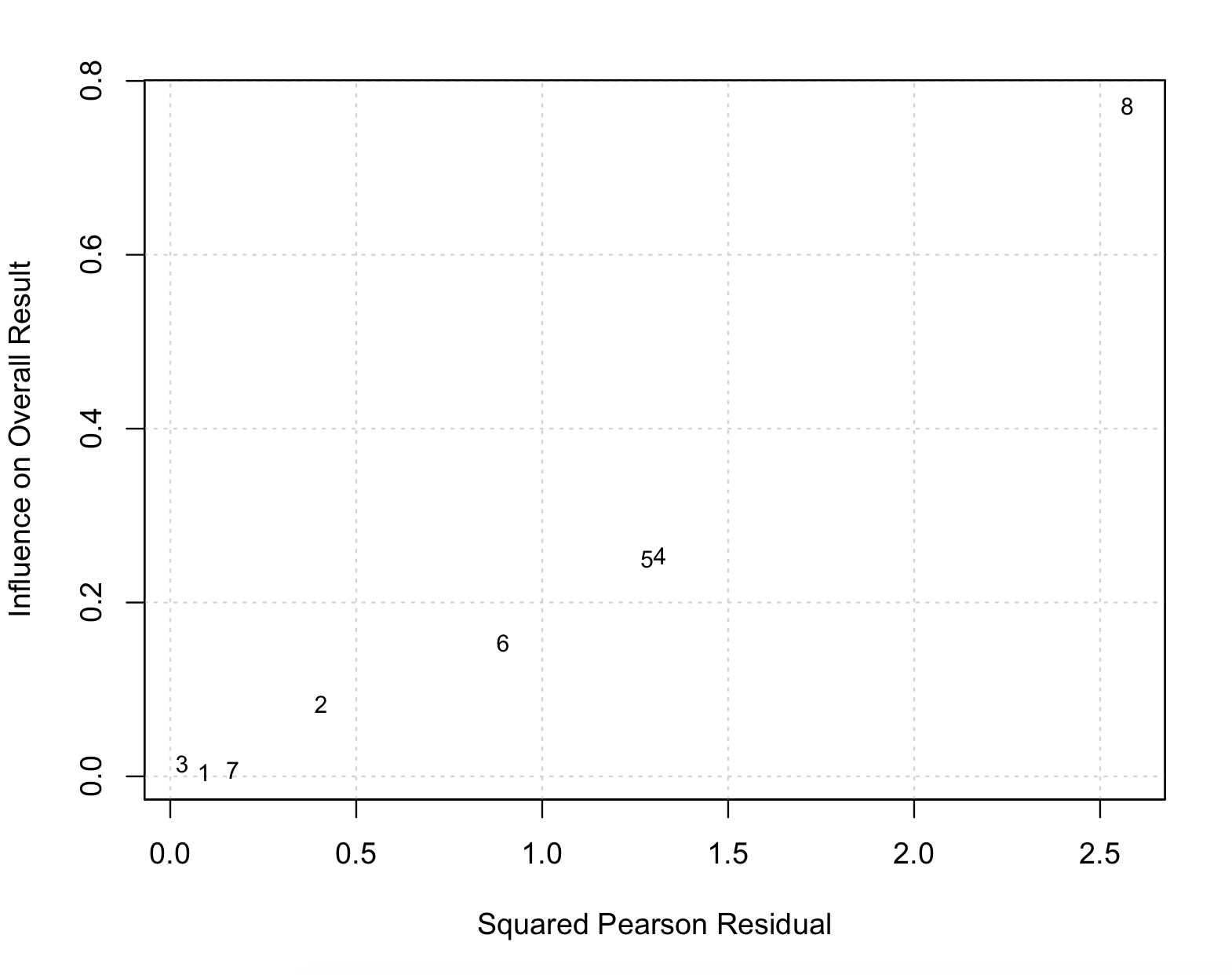
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Year** | **n** | **Mean age** | ***r*** | **HPB Measure** | **LoC Measure** |
| Chuang et al | 2016 | 56 | 43.6 | -0.03 | HPLP-11 | MHLC |
| Jaeger et al. | 2014 | 69 | 42.6 | -0.18 | MARS | MHLC |
| Modestin et al. | 2009 | 60 | 37 | -0.11 | ISOS | IPC |
| Surmann et al. | 2017 | 80 | 38.2 | -0.25 | ISMI | FKK |
| Myers | 1997 | 50 | 37 | 0.12 | ITAQ | MHLC |
| Combes & Feral | 2010 | 65 | 37.1 | -0.23 | MARS | MHLC |
| Retherford | 2005 | 19 | 46.5 | 0.03 | HBC | MHLC |
| Hoffmann et al. | 2000 | 46 | 27.6 | 0.21 | JankeScale | IPC |

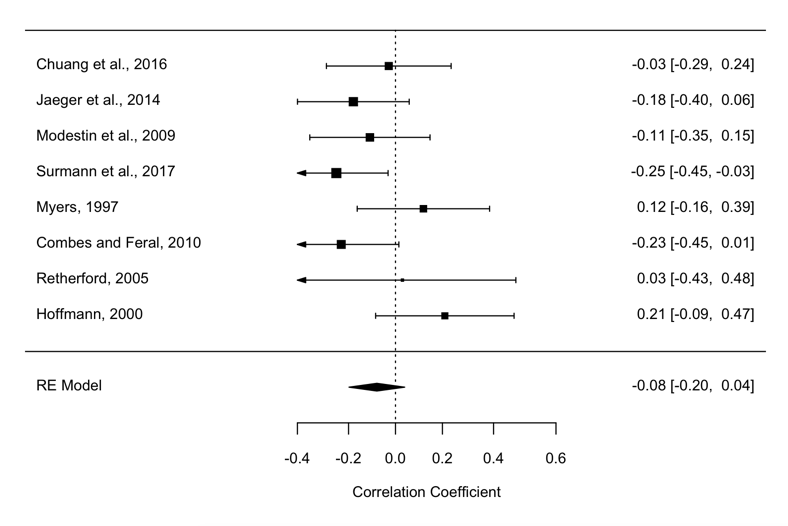
*Table 11:* Overview of study data for internal LOC

Hypothesis 2.b stated that an external chance LOC orientation would be negatively correlated with the presence of HPBs. Analysis reveals a non-significant effect size of -0.08 (95% CI = -0.20, 0.04, *p*=0.19) indicating a small negative effect (Cohen, 1988, p.79) of external chance LOC on the presence of HPBs.

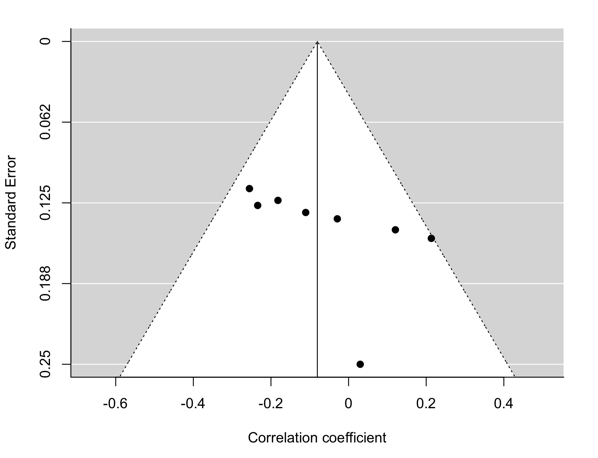
Cochran’s test for heterogeneity was significant Q(8) = 10.44, p = .12 and *I*2 was 34.71% (95% CI; 17.98, 90.28) indicating low variance (Higgins et al., 2003). The Baujat plot in figure x show one study in the top right quadrant clearly making the biggest contribution. Again, potential causes of heterogeneity between studies and the impact on the results of the meta-analysis will be discussed in the discussion. The forest plot illustrated in figure x shows a sample of heterogeneous studies with differing size confidence intervals of which three have been trimmed. Five studies to left of the dotted line represent external chance LOC having a negative correlation with HPBs. Unlike internal and powerful others, there is not as much consistency in the size of the squares indicating impact on the summary effect size. The diamond at the bottom straddles vertical dotted line (to the left) mirroring the negative correlation whilst also indicating the null hypothesis cannot be rejected (Sedgwick, 2012).

The funnel plot (figure 7) shows some degree symmetry indicating, Egger's regression test is not significant (p = 0.63) but is bordering and the Rank correlation test is significant (p < 0.01). Of note also is that one study (Haley et al., 2003, did not report scores for change LOC. Again, the subject of publication biases and inconsistencies will be returned to in the discussion.





*Figure 12:* Forest plot of chance LOC.



*Figure 13:* Funnel plot of chance LOC.

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