Neuropsychol Rev (2016) 26:376–393
DOI 10.1007/s11065-016-9332-2

REVIEW

Subjective Cognitive Complaints and Objective Cognitive Function in Aging: A Systematic Review and Meta-Analysis of Recent Cross-Sectional Findings

Bridget Burmester[1] · **Janet Leathem**[1] · **Paul Merrick**[2]

Received: 29 November 2015 / Accepted: 19 September 2016 / Published online: 6 October 2016

Abstract Research investigating how subjective cognitive complaints (SCCs) might reliably indicate impairments in objective cognitive functioning has produced highly varied findings, and despite attempts to synthesise this literature (e.g., Jonker et al. *International Journal of Geriatric Psychiatry, 15*, 983–991, 2000; Reid and MacLullich *Dementia and Geriatric Cognitive Disorders, 22*(5–6), 471–485, 2006; Crumley et al. *Psychology and Aging, 29*(2), 250–263, 2014), recent work continues to offer little resolution. This review provides both quantitative and qualitative synthesis of research conducted since the last comprehensive review in 2006, with the aim of identifying reasons for these discrepancies that might provide fruitful avenues for future exploration. Meta-analysis found a small but significant association between SCCs and objective cognitive function, although it was limited by large heterogeneity between studies and evidence of potential publication bias. Often, assessments of SCCs and objective cognitive function were brief or not formally validated. However, studies that employed more comprehensive SCC measures tended to find that SCCs were associated independently with both objective cognitive function and depressive symptoms. Further explicit investigation of how assessment measures relate to reports of SCCs, and the validity of the proposed 'compensation theory' of SCC aetiology, is recommended.

Keywords Subjective cognitive complaints · Subjective memory complaints · Memory impairment · Cognitive impairment · Aging

Many adults report an increasing number of memory and other cognitive difficulties as they grow older (Jonker et al. 2000; Ponds et al. 2000) and often these are interpreted as indicators of cognitive decline and age-related cognitive disorders such as Alzheimer's disease and other forms of dementia (Paradise et al. 2011). Subjective memory complaints in particular are a key diagnostic criterion for mild cognitive impairment (MCI), a transitional stage between normal age-related cognitive changes and those associated with dementia. However, recent literature has highlighted the questionable diagnostic validity of memory complaints for MCI (Stewart 2012), due to mixed evidence regarding their link with objectively detectable memory impairments. Hence it is important to understand subjective cognitive complaints (SCCs) for their potential value in predicting the development of clinically relevant conditions. Additionally, middle-aged adults display high levels of worry about their memory functioning and future decline (Lachman 2004), yet relatively few go on to develop cognitive disorders later in life. Thus SCCs may in fact signify a potentially unnecessary concern, which could be addressed through psychoeducation if research establishes that their predictive value is low. Despite a large number of studies investigating the link between SCCs and objective cognitive functioning, and existing reviews of this literature, subsequent work has not reached any further agreement on whether SCCs can be considered a reliable indicator of current impairment or risk of future cognitive decline.

This review will summarise the findings of recent literature in this area, and provide an update of work published since the last comprehensive review of cross-sectional studies by Reid

✉ Bridget Burmester
bridget.burmester.2@uni.massey.ac.nz

[1] School of Psychology, Massey University, PO Box 756, Wellington 6140, New Zealand

[2] School of Psychology, Massey University, Private Bag 102 904, Auckland 0745, New Zealand

and MacLullich (2006). The findings of existing reviews on this topic will be discussed in chronological order, followed by literature that has emerged since. Similarities and differences in findings will be examined, with a particular focus on other variables and methodological variations that may have influenced results, and subsequent suggestions will be made for areas that hold promise in clarifying the value of SCCs.

Early Reviews

Jonker and colleagues (2000) The first review of evidence concerning the relationship between subjective and objective cognition was specific to *memory* complaints and performance. Jonker et al. (2000) examined ten cross-sectional studies, and found that the association between memory complaints and memory performance depended on characteristics of the participants. Specifically, participants who self-referred to memory clinics tended to report memory complaints that were associated with their level of depressive symptomatology, whereas hospital-based samples showed a more consistent link between complaints and memory performance. Self-referred participant samples tended to be younger and thus there was less likelihood of age-related memory impairment being present. In contrast, complaints in relatively older samples were related to impairment, even after adjusting for depressive symptoms.

Jonker et al. (2000) also reviewed ten longitudinal studies that reported the association between memory complaints at a baseline data collection phase and cognitive outcomes at various follow-up periods. Here, findings were more consistent, with memory complaints predicting future dementia diagnoses (where the follow-up period was at least two years) and general cognitive decline (in follow-up periods as little as one year). Furthermore, this relationship was often found even when participants with depressive symptoms were excluded from analyses. The link was especially true for participants diagnosed with MCI at baseline, and also held greater value for participants who did not have baseline MCI but who were highly educated. The authors suggest that this specificity may be because highly educated participants are more sensitive to subtle changes in their cognitive functioning, although they still perform relatively well on objective tests due to the ceiling effects of commonly used short screening tests such as the Mini Mental State Examination (MMSE).

Ultimately, Jonker et al. (2000) concluded that memory complaints in older adults could be signs of future decline and conditions such as dementia, and therefore they warranted further investigation by clinicians. Even in cases where there was no evidence of memory impairment and complaints might be thought to reflect depressive symptoms instead, the possibility of future decline should not be discounted and SCCs still monitored for change and functional impact.

Reid and MacLullich (2006) Following on from Jonker et al. (2000), Reid and MacLullich (2006) aimed to include more recent literature on the link between subjective and objective memory, and to investigate the impact of depression and neuroticism on findings. Six population-based cross-sectional studies were selected after omitting those that recruited participants via self-referral or health care practitioners. Some studies reported positive associations between memory complaints and memory impairment, but were vulnerable to methodological limitations such as non-validated measures of complaints, limited assessment of objective functioning, and failing to assess confounding depression and/or personality variables. Other studies with more comprehensive measures of objective function reported weak or no associations between complaints and performance. Reid and MacLullich (2006) concluded that the methodological limitations of all cross-sectional studies meant that there was insufficient evidence to make definitive statements about the link between subjective memory complaints and objective memory impairment.

Fifteen longitudinal studies were also examined for links between memory complaints and later cognitive decline, and here the authors agreed with the conclusions of Jonker et al. (2000) that memory complaints at baseline did predict later cognitive decline or dementia. However, they highlight that the predictive value of memory complaints might still be somewhat limited in this regard, and evidence of memory impairment at baseline might also be needed in order for greater predictive power. Methodological limitations were also detrimental to longitudinal studies, with non-validated assessments of complaints again being widely used, and a relative lack of measurement of other variables such as depression and personality factors.

Evidence from studies that did examine the role of depression and personality traits led Reid and MacLullich (2006) to conclude that these variables were more strongly related to subjective memory complaints than was objective memory impairment. They highlighted that depression and personality variables were related to memory complaints even in the absence of clinical levels of depression, and that links between depression or neuroticism and performance on cognitive testing might in fact explain any consequent association between objective impairment and subjective complaints. This conclusion conflicts with an assertion from Jonker et al. (2000) that subjective complaints and objective impairment were related in older cohorts even when controlling for depression. Such discrepancies, combined with the considerable methodological limitations mentioned in both reviews, points to a need for still further research that attempts to account for such problems.

Recent Reviews

More recently, three notable reviews have emerged and are briefly summarised here. The first included both cross-

sectional and longitudinal studies, while the latter two were limited to longitudinal studies only.

Crumley, Stetler, and Horhota (2014) These authors conducted a meta-analysis of studies to February 2012 that examined the relationship between subjective and objective memory in aging. Over 53 studies and 20,319 participants, a significant but very small effect size was observed, where subjective memory measures explained less than 1 % of the variance in participants' performance on objective memory measures. Further, the effect was moderated by a number of demographic and measurement-related variables, with the relationship being stronger for participants who were generally older, female, well educated, and less depressed, and when subjective memory was assessed by questionnaires rather than interviews (the longer the better), interpreted as capacity of memory rather than complaints, and included measures of prospective, objective memory. However, a major limitation of this review was that the terms used to search databases for literature included the names of five specific questionnaires about subjective memory, meaning that the studies included were likely limited to only those that included at least one of these measures. Given that the assessment of subjective memory varies widely with no established common measures or methods (Rabin et al. 2015), the use of narrow search terms potentially excludes a large number of relevant studies that used other questionnaires or any non-questionnaire methods of assessment. Further, this study did not make any distinction between cross-sectional and longitudinal studies reviewed, unlike previous reviews. This is surprising given that earlier reviews highlighted different conclusions regarding these two types of studies (Jonker et al. 2000; Reid and MacLullich 2006), and thus conflating the two increases the potential error in findings.

Mitchell, Beaumont, Ferguson, Yadegarfar, and Stubbs (2014) This study was a meta-analysis of the longitudinal value of subjective memory complaints for predicting MCI and dementia. Thirty-two studies representing a total of 29,723 participants were analysed, with an average follow-up period of 4.8 years. Over this time, the rates of conversion to dementia were approximately twice as high (i.e., 2.3 % vs. 1 %) for participants who reported memory complaints at baseline assessments than those who did not report complaints. Rates of conversion to MCI were also increased for participants with initial memory complaints. The authors concluded that subjective memory complaints have significant clinical value as prognostic indicators, however a major limitation of the work to date is the heterogeneity between samples and studies (e.g., community-based vs. memory clinic samples, definitions of memory complaints, assessment of different types of complaints).

Mendonça, Alves, and Bugalho (2016) This study also focused on the use of SCCs (not just memory complaints) as an indicator of later dementia diagnoses, and presented a systematic review of seventeen studies. Their conclusions parallel those of Mitchell et al. (2014) in that the risk of developing dementia was 1.5–3 times greater for participants with SCCs at baseline. They highlight that despite the increased risk, the overwhelming majority of participants with SCCs do not develop dementia (at least within the time courses measured). Issues affecting the predictive value of SCCs were also noted, including the influence of depressive symptoms, the lack of a "gold standard" validated measure of SCCs, and confounding of different aspects of SCCs (e.g., severity vs. frequency vs. functional impact).

Current Review

Despite a persistent lack of clarity regarding their value as indicators of impairment, SCCs remain of interest to researchers and clinicians because they are so salient to participants and patients (Begum et al. 2012; Paradise et al. 2011. Accurate perceptions of one's own memory functioning is necessary in order to engage with effective interventions and compensatory strategies (Lachman and Andreoletti 2006), and prevent subsequent negative impacts of SCCs on mood and self-efficacy (Mol et al. 2007). As such, a sound understanding of the conditions under which SCCs can have greatest predictive value is warranted given the abundance of new studies that have emerged since the last review on this topic (Reid and MacLullich 2006). The current review will discuss this recent literature and provide an update of previous review findings, as well as providing a quantitative assessment of the association between SCCs and objective cognitive functioning in the form of a meta-analysis. Where early reviews examined both cross-sectional and longitudinal studies, this review is limited to cross-sectional studies only, as the longitudinal value of SCCs has been more recently examined in depth (see Mendonça et al. 2016; Mitchell et al. 2014) while the most recent review of cross-sectional work was limited to studies which included prescribed subjective measures and conflated these with longitudinal findings (Crumley et al. 2014). As in previous reviews, methodological choices, the contribution of depression, and other major confounds in the relationship between SCCs and objective performance are considered throughout.

This review also considers the broader category of subjective *cognitive* complaints rather than limiting findings to memory complaints specifically. While previous work has concentrated on memory complaints specifically, and sometimes conflated these with other types of subjective cognitive complaints (e.g., Clément et al. 2008; Hohman et al. 2011), recent work emphasises the value of all types of cognitive

complaint (Rabin et al. 2015). This distinction is addressed in the current review through analysis of how complaints relate to performance at the broad cognitive level as well as specific to memory complaints and performance.

Recent progress in the field has highlighted the relationship between SCCs and biological factors such as amyloid deposits and apolipoprotein E e4 alleles (e.g., Amariglio et al. 2012; Buckley et al. 2013), however these are outside the scope of the current review. Here, analysis is limited to behavioural and cognitive correlates of SCCs as these reflect the focus on the significance of SCCs in normal aging rather than in disease-related processes, and signify the factors which are more immediately accessible to most clinicians and the general public.

Reid and MacLullich (2006) excluded cross-sectional studies that used community-based samples of volunteer participants, but these are included in the present review in order to better reflect findings from all samples. While volunteer samples are subject to selection biases, they do comprise the majority of studies regarding SCCs and objective cognitive functioning, and also reflect the effects of SCCs in the very people for which they cause most distress. Therefore, knowledge about how SCCs in these samples relate to cognitive performance is important in understanding how best to alleviate this distress.

Method

Articles were selected from PsycINFO and Web of Science using the following keyword search terms: (subjective memory complaints OR subjective cognitive complaints OR subjective memory decline OR subjective cognitive decline) AND (memory impairment OR cognitive impairment OR cognitive disorder OR memory decline OR cognitive decline). Inclusion criteria were that the articles were published between January 2006 and May 2016 (inclusive), and concerned the relationship between SCCs and cognitive performance or impairment in aging. Articles were excluded if they were not in English, were not a peer-reviewed research study (i.e., a review, editorial, conference proceedings or dissertation), did not contain a measure of either SCCs or cognitive function or did not report the association between these two variables, sampled or contained a majority of participants from a special population (e.g., people with chronic fatigue syndrome, epilepsy, MCI, or perimenopausal women), did not explicitly aim to examine the cross-sectional association between SCCs and cognitive function, reported only longitudinal associations, or only reported associations for groups which included a majority of participants younger than 40. Titles were screened first, followed by abstracts and then full article texts. Figure 1 shows the number of articles included at each stage of selection. This process resulted in the inclusion of 53 studies.

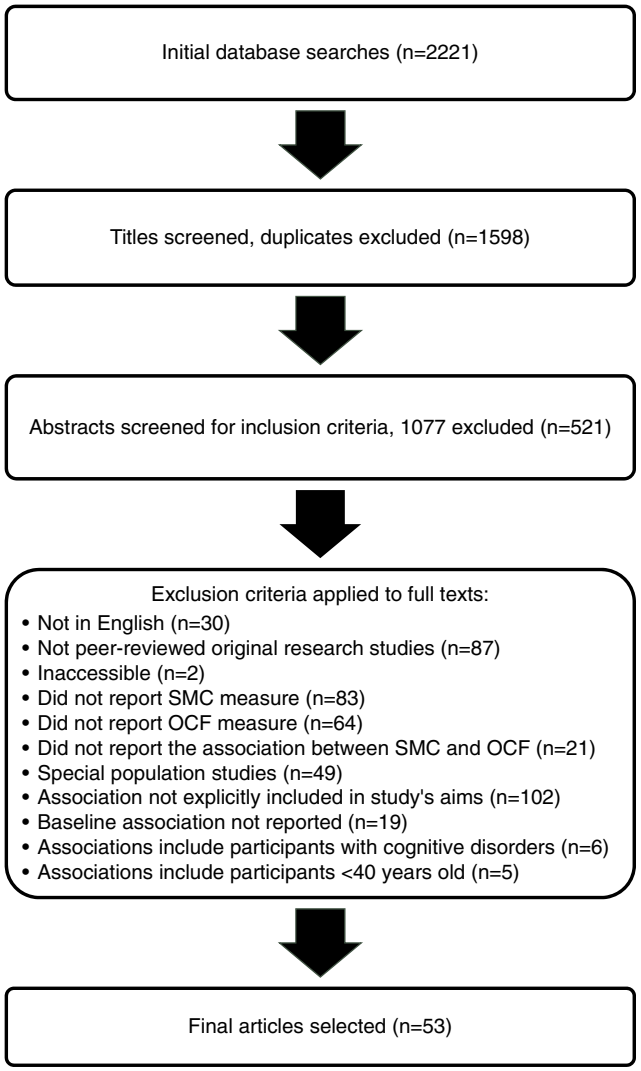

Fig. 1 Selection process for study inclusion

Notes on Terminology Many different measures of various aspects of memory and other cognitive functions have been used among the studies reviewed here, and the terms used to refer to these constructs can foster some confusion. Here, *memory* performance or impairment refers scores on memory-specific measures (e.g., Rey Auditory Verbal Learning Test), whereas *cognitive* performance or impairment is used to describe scores on a broader range of cognitive measures (not specific to memory, e.g., MMSE).

As noted earlier, literature has conflated the terms *memory complaint* and *cognitive complaint*, although the former would intuitively appear to be a sub-category of the latter. Study participants also appear to categorise a range of non-memory related difficulties (such as difficulty concentrating) as memory-related difficulties (Apolinario et al. 2012; Snitz et al. 2015, and global measures of subjective cognitive functioning often refer only to memory specifically (Rabin et al. 2015; Snitz et al. 2015). Consequently, the term *subjective cognitive complaint* will be used here to refer to reported

difficulties of both memory and other cognitive domains (consistent with recommendations from Reisberg and Gauthier 2008), although it is acknowledged that many studies may only explicitly assess memory complaints specifically. However, both *memory complaint* and *cognitive complaint* are included in the search terms in order to maximise the number of potential studies identified for review.

Finally, lay perceptions of the term *complaint* can carry pejorative connotations for participants and the general public. Here, this term is retained in order to be consistent with previous academic literature, however we recommend use of more validating terms (such as *symptoms*, *problems*, or *difficulties*) in clinical and other public settings. Indeed, measures of subjective cognitive functioning often use such language in their questions (e.g., "Do you have memory problems?"; Montejo et al. 2011).

Statistical Analysis

Pearson *r* correlations between subjective memory complaints and objective cognitive performance were extracted from each included study. Where studies reported more than one effect size, the resultant correlations were averaged to give an overall effect size for that study. Where a study reported both cross-sectional and longitudinal data, only one set of cross-sectional results (usually baseline data) was included in this review. Where multiple studies were linked to the same participant pool, only data from the study with the larger sample size was used. Where studies included a subset of participants with cognitive impairments (e.g., MCI, dementia), only data from cognitively normal participants was used (where available). When this information was not available, studies were only included if the proportion of participants with cognitive impairment was less than 20 %. All quantitative meta-analysis procedures were conducted with Meta-Essentials, using a random effects model which balances the relative weights of effect sizes so that studies with large sample sizes do not overshadow the contributions of smaller studies to the analysis (Borenstein et al. 2010).

Results

Meta-Analysis

After excluding studies with duplicate participant pools ($n = 3$), 50 studies were included in the meta-analysis. These studies represented a total of 58,778 participants (56,873 cognitively unimpaired; $M = 1159.20$, $SD = 2789.68$, range = 23 to 16,964). Full details of the studies' characteristics are shown in Table 1.

The meta-analysis model showed a small but significant correlation between subjective memory complaints and objective cognitive performance ($r = -.13$, 95 % CI [−.16, −.10], $Z = -.26$, $p < .001$), where greater or more severe memory complaints were associated with poorer performance on cognitive tests. Effect sizes with 95 % confidence intervals for all studies are shown in Fig. 2. Although Orwin's fail-safe N was relatively large (119), a funnel plot indicated potential influence of publication bias (reducing the estimate of effect size to $r = -.09$; see Fig. 3), and effect sizes were significantly heterogeneous ($Q(49) = 1504.37$, $p < .001$, $I^2 = 96.74$ %), necessitating a cautious approach to interpretation.

Due to the high degree of heterogeneity among studies, subgroup analyses were conducted. Firstly, correlations specific to measures of memory only (both subjective and objective) were analysed as a subgroup. Secondly, studies that only reported effect sizes after controlling for other variables (e.g., age, gender, education) were analysed separately from those that reported effect sizes without controlling for other variables. Thirdly, studies were analysed in groups according to whether their measure of SCCs was a global question (e.g., "Do you have problems with your memory?"), a number of specific examples (e.g., "Do you forget where you have put things?") as in a questionnaire, or a mix of both types. Finally, studies which screened for, and did not include any participants with, cognitive impairment were analysed separately to those that potentially or explicitly included participants with cognitive impairment. Results of all subgroup meta-analyses are shown in Table 2. The largest correlations obtained were for studies that used global measures of SCCs and when all participants with cognitive impairment were excluded from analyses ($r = -.16$ for both). Heterogeneity was most reduced when only measures specific to memory were included in the analysis ($I^2 = 74.26$ %).

Subsidiary Analysis

Due to the large heterogeneity among studies, and small numbers of studies which shared the same categories of moderator variables in some instances (e.g., used the same measure of depression, excluded participants with cognitive impairment, and reported data without controlling for other variables), studies included in the meta-analysis are discussed in further detail here, along with a review of the influence of potential moderator variables.

Evidence for a Link between SCCs and Objective Performance Since 2006, many cross-sectional studies have found evidence that SCCs are associated with performance on objective tests of cognitive functioning. However, often the exact nature of this link has been unclear. For example, studies of relatively small numbers of community dwelling volunteers found that SCCs (as assessed via the Everyday Memory

Table 1 Characteristics of Included Studies

Study	*N*	Age range (M±SD)	% female	CI (*n*)	SMC	Objective cognitive function	Depression	Controlled variables	Cognition		Memory	
									k	*r*	*k*	*r*
Amariglio et al. (2011)	16964	70-81 (74±1.5)	100.00	NS	2	1, 2, 5, 7	1	1, 4	28	-0.07	7	-0.08
Balash et al. (2013)	636	50-98 (68±9.8)	61.10	0	1	1	3	-	1	-0.11	1	0.00
Benito-León et al. (2010)	2146	65+ (75.7±5.85)	60.50	337	1	1, 2, 5, 7, 8	1	-	11	-0.04	5	-0.05
Brucki and Nitrini (2009)	163	50+ (62.3±9.16)	50.30	NS	1	1, 2		-	6	-0.17	4	-0.19
Buckley et al. (2013)	674	NR (72.7±6.7)	58.00	0	3	2	2, 9	1, 3, 8	3	-0.10	3	-0.10
Buelow et al. (2014)	84	55+ (68.5±8.64)	68.00	0	2	1, 2		1, 3	7	-0.01	3	-0.13
Calabria et al. (2011)	112	NR (70.8±6.2)	77.68	10	2	2		-	1	-0.14	1	-0.14
Caramelli and Beato (2008)	60	60-91 (69.9±6.3)	65.00	0	3	2, 3, 5, 6	10	-	10	-0.10	5	-0.08
Chin et al. (2014)	108	50+ (63.35±7.33)	70.37	0	2	2, 3, 5, 7	3	-	11	0.02	3	-0.01
Clément et al. (2008)	81	50-87 (68.59±8.2)	87.43	0	2	1, 2, 5, 6	4	2	18	-0.07	6	-0.15
Cook and Marsiske (2006)	57	65+ (74.77±5.03)	63.20	0	2	1, 2, 5, 7, 8	2, 5	-	5	-0.12	2	-0.17
Cooper et al. (2011)	2022	60+ (NR)	NR	0	1	1	11	-	2	-0.08	-	-
de Jager et al. (2009)	98	60+ (77.18±5.9)	NR	0	3	1, 2, 3, 4		1, 2, 3	12	-0.16	5	-0.14
Dux et al. (2008)	130	NR (76.7±8.5)	71.80	0	2	1, 2	2	-	3	-0.28	3	-0.26
Fernández-Blázquez et al. (2016)	608	70-85 (74.14±3.83)	62.00	0	2	1, 2, 4, 5, 6	2	-	16	-0.06	9	-0.07
Gavett et al. (2011)	384	60+ (70.37±6.6)	100.00	0	2	1, 2, 5	2	-	4	-0.07	-	-
Genziani et al. (2013)	2775	65+ (74.3±NR)	60.70	0	1	2, 5	5	-	3	-0.10	1	-0.09
Grambaite et al. (2013)	23	45-79 (48.8±7.2)	56.50	0	1	2, 3, 5	3, 8	-	8	-0.34	2	-0.38
Jacinto et al. (2014)	248	65+ (NR)	NR	21	1	1	3	-	1	-0.38	-	-
Juncos-Rabadan et al. (2012)	580	50+ (NR)	69.10	0	2	1, 2	3	-	1	-0.15	-	-
Langlois and Belleville (2014)	115	45-87 (67.6±8.9)	82.00	0	2	1, 2, 4, 5, 6, 7	4	-	62	-0.04	21	-0.11
Lee et al. (2016)	77	60+ (NR)	53.00	0	3	2	7	1, 3, 4, 5, 6	2	-0.10	2	-0.10
Lucas et al. (2016)	72	61-78 (66.57±3.79)	72.20	0	2	1, 2, 4, 5	9	-	4	-0.29	4	-0.29
Martins et al. (2012)	479	50-95 (66±9.1)	60.30	0	2	2, 3, 4, 5, 7	3	1, 2, 4, 7	30	0.04	8	-0.06
Mendes et al. (2008)*	292	18-87 (50.5±17.1)	48.00	0	2	2	3	-	4	-0.05*	-	-
Merema et al. (2012)	121	66-90 (73.83±6.34)	67.00	0	2	2, 8	7	-	5	-0.09	4	-0.14
Mewton et al. (2014)	1905	65-85 (NR)	52.63	297	1	1	12	-	4	-0.16	-	-
Minett et al. (2008)	114	50+ (66.15±NR)	88.00	0	3	1, 2, 3, 4, 5	3	-	14	-0.11	4	-0.05
Mol et al. (2006)	557	55+ (67.53±7.59)	49.45	0	1	2, 4, 5	8	1, 2, 3, 4, 5	5	-0.08	2	-0.09
Montejo et al. (2011)	1618	65+ (74.67±6.91)	60.42	0	1	1	1	-	1	-0.54	-	-
Montejo et al. (2014)	269	65-87 (71.47±5.03)	75.84	0	3	1, 2	2	-	6	-0.12	4	-0.12
Ossher et al. (2013)	105	65+ (75.3±6.8)	66.00	0	2	1, 2		-	3	-0.14	2	-0.09
Parisi et al. (2011)	1401	65+ (73.8±6)	75.00	0	2	2	5	1, 2, 3, 4, 9, 10	1	-0.29	1	-0.29
Park et al. (2007)	9477	65+ (72.61±5.76)	60.60	1189	1	1, 2, 5, 6		-	1	-0.42	-	-

Table 1 (continued)

Study	*N*	Age range (M±SD)	% female	CI (*n*)	SMC	Objective cognitive function	Depression	Controlled variables	Cognition		Memory	
									k	*r*	*k*	*r*
Pearman et al. (2014)	406	70-103 (83.33±8.45)	50.00	0	3	2	13	-	1	-0.08	-	-
Ramlall et al. (2013)	302	60-94 (73.5±7.7)	72.22	51	1	1	2	-	2	-0.02	-	-
Rijs et al. (2013)	891	55-64 (60.19±2.87)	52.36	0	1	2		1, 2, 11	2	-0.07	2	-0.07
Rönnlund et al. (2011)	255	60-90 (NR)	48.80	0	2	2	5	-	1	-0.05	-	-
Rouch et al. (2008)	907	62-68 (NR)	60.75	0	2	1, 2, 3, 4, 5	14	2, 3	17	-0.02	6	0.08
Shmotkin et al. (2013)	164	87-106 (NR)	57.00	NS	1	1	5	-	2	-0.07	-	-
Sims et al. (2011)	579	48-95 (68.99±9.68)	75.10	0	3	1, 2, 3	5	-	6	0.00	6	0.00
Snitz et al. (2008)	276	65-93 (73.2±5.6)	58.00	0	1	2, 4, 5, 7	6	-	12	-0.16	6	-0.20
Steinberg et al. (2013)	125	65-95 (77±7.2)	66.00	0	2	2, 3, 4, 5	3, 7	1, 2, 3, 9	9	-0.17	3	-0.16
Stenfors et al. (2013)	233	25-67 (48.67±10.39)	75.97	NS	NR	3, 5	8, 15	1, 2, 3	8	-0.12	-	-
Tomita et al. (2014)	394	60+ (68.7±6.3)	64.97	0	1	1	5	1, 2, 3, 4	1	-0.02	-	-
Trouton et al. (2006)	647	65-99 (75.8±NR)	59.94	0	3	1, 2	16	-	1	-0.32	-	-
van Oijen et al. (2007)	6927	55+ (69.5±9.1)	60.00	0	1	1	1	1, 2	1	-0.13	-	-
Waldorff et al. (2012)	753	65+ (NR)	61.21	0	1	1		-	1	-0.05	-	-
Zeintl et al. (2006)	364	65-80 (73±4.43)	46.00	0	2	2	3	-	1	-0.09	1	-0.09
Zlatar et al. (2014)	1000	51-99 (77.3±12.2)	51.40	0	2	1	17	-	1	-0.12	-	-

N sample size used in meta-analysis, *M* mean, *SD* standard deviation, *NR* not reported, *CI* (*n*) number of participants with cognitive impairment, *NS* no screen used, *SMC* subjective memory complaint measure type: 1 = global measures, 2 = specific examples, 3 = mixed; Objective cognitive function domains assessed: 1 = global, 2 = memory, 3 = attention/working memory, 4 = speed, 5 = executive functioning, 6 = visual-spatial abilities, 7 = language, 8 = pre-morbid functioning; Depression measure: 1 = global question(s), 2 = Geriatric Depression Scale (GDS; 30 items), 3 = GDS (15 items), 4 = GDS (5 items), 5 = Center for Epidemiological Studies Depression scale (CES-D), 6 = modified CES-D, 7 = Depression, Anxiety and Stress Scale – depression subscale, 8 = Symptom Checklist, 9 = Hospital Anxiety and Depression Scale (depression subscale), 10 = Cornell Scale for Depression, 11 = Revised Clinical Interview Schedule (depression subscale), 12 = World Mental Health Composite International Diagnostic Interview diagnosis, 13 = Hamilton Depression Scale, 14 = QD2A questionnaire, 15 = Major Depression Inventory, 16 = short Comprehensive Assessment and Referral Evaluation interview (depression subscale), 17 = Patient Health Questionnaire; Controlled variables: 1 = age, 2 = gender, 3 = education, 4 = depression, 5 = anxiety, 6 = stress, 7 = household type, 8 = apolipoprotein E4 allele status, 9 = ethnicity, 10 = health, 11 = region; *k* number of effect sizes, *r* Pearson correlation

*Correlation relates only to data for participants aged 40+ (*n* = 205)

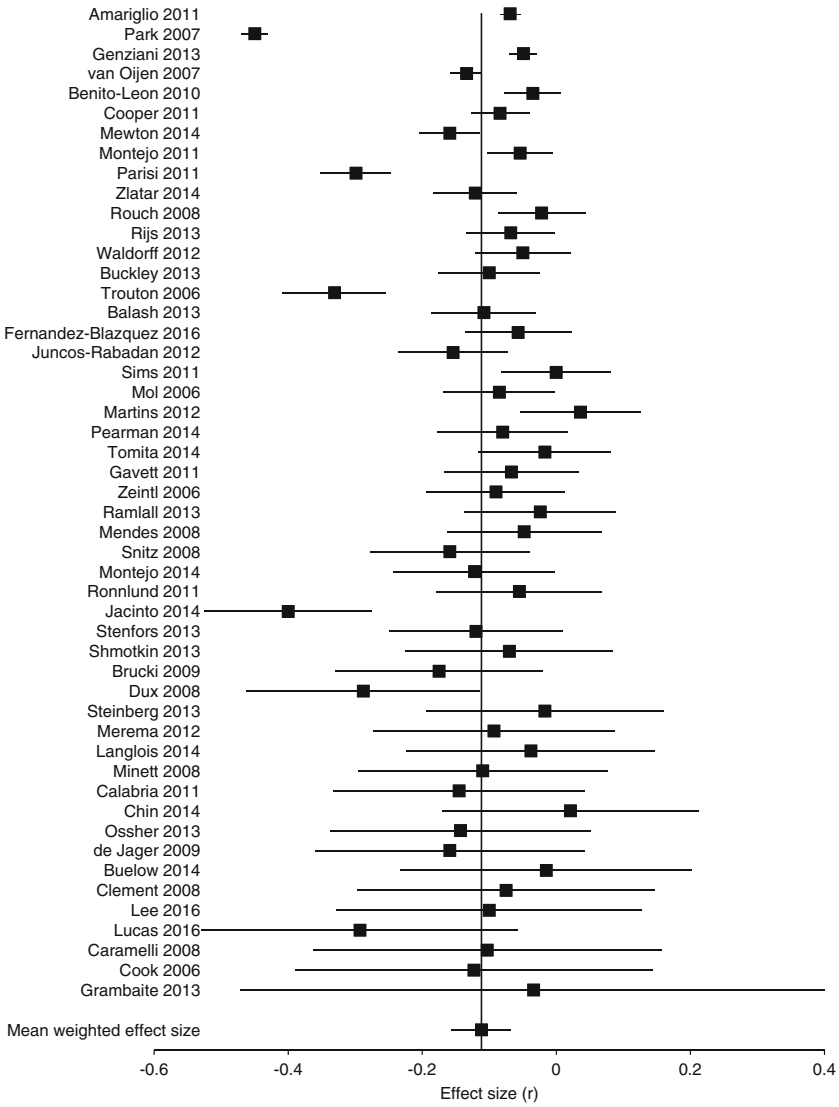

Fig. 2 Forest plot of individual and mean weighted effect sizes. Individual effect sizes are displayed in order of standard error (smallest to largest). The vertical line represents the mean weighted effect size (.13)

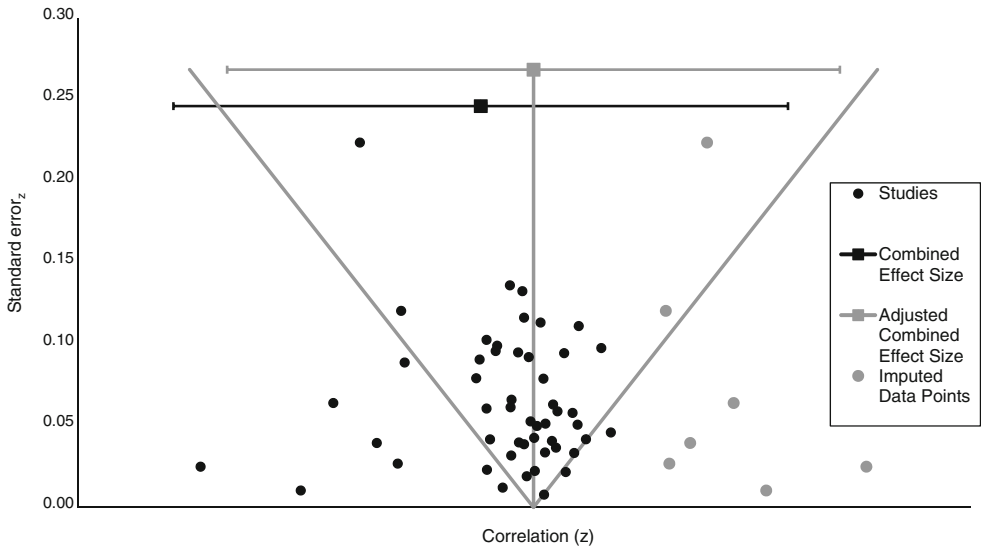

Fig. 3 Funnel plot of observed studies' effect sizes and corrections for potential publication bias

Table 2 Results of Subgroup Meta-Analyses

Category	Subgroup	n	r	95 % CI (lower)	95 % CI (upper)	Q	p(Q)	I^2 (%)
Participants with cognitive impairment	Potentially included	10	-.12	-.16	-.08	967.12	<.001	99.07
	Excluded	40	-.16	-.27	-.06	506.68	<.001	92.30
Influence of other variables	Controlled	15	-.15	-.19	-.10	97.72	<.001	85.67
	Uncontrolled	35	-.09	-.14	-.05	1061.22	<.001	96.80
SCC measures	Global	18	-.16	-.25	-.08	1049.58	<.001	98.38
	Specific	22	-.10	-.14	-.06	95.61	<.001	78.04
	Mixed	9	-.12	-.20	-.05	37.15	<.001	78.46
Objective measures	Memory only	32	-.10	-.13	-.07	120.43	<.001	74.26
Overall		50	-.13	-.16	-.10	1504.37	<.001	96.74

Questionnaire or four questions from the Cambridge Mental Disorders of the Elderly Examination [CAMDEX]) were associated with greater rates of diagnosed cognitive impairment (Jacinto et al. 2014) or poorer performance on tests such as the MMSE and CAMDEX objective assessment of functioning (Calabria et al. 2011; de Jager et al. 2009; Ossher et al. 2013). Population-based samples have also shown associations between SCCs and poorer performance on both global measures of cognition (Montejo et al. 2011; Waldorff et al. 2012) and verbal memory specifically (Rijs et al. 2013). However, these studies were all limited by either brief global assessments of cognition rather than performance on more specific tests (Calabria et al. 2011; de Jager et al. 2009; Montejo et al. 2011; Ossher et al. 2013) or single-question measures of SCCs (Jacinto et al. 2014; Rijs et al. 2013; Waldorff et al. 2012).

All of these studies also omitted a measure of depressive symptoms, which have been highlighted in previous work (e.g., Reid and MacLullich 2006) as one of the most important confounds in explaining potential links between SCCs and objective performance. Further studies assessed depression but did not include it as a potential statistical confound and so the weight of their conclusions is also limited. Balash et al. (2013) and Steinberg et al. (2013) found SCCs to be associated with depression and objective cognitive performance, but as analyses were limited to correlations, collinearity effects could not be disentangled. Similarly, Grambaite et al. (2013) found that depressive symptoms predicted SCCs and objective performance, but did not examine these variables in a joint model. Fernández-Blázquez et al. (2016) also report that participants with SCCs tended to have lower objective test scores along with more depressive symptoms, however did not examine the interaction of these effects. Finally, van Oijen et al. (2007) found MMSE scores were significantly higher in participants without SCCs than those with SCCs regardless of whether participants with a history of depression were included in the analyses, however their focus was on longitudinal risk factors and so the cross-sectional influence of depressive symptoms was not explicitly examined.

Evidence for the Influence of Depression Some studies that have statistically accounted for the influence of depression on the SCC-objective performance relationship report evidence that any association between SCCs and objective performance is reduced or eliminated once the effects of depressive symptoms are accounted for. For example, Balash et al. (2013) found the presence of SCCs in cognitively healthy participants was associated with greater depressive symptoms regardless of the participants' MMSE scores. Similarly, Zlatar et al. (2014) found that SCCs were predicted by depressive symptoms irrespective of cognitive performance. Zeintl et al. (2006) also found depressive symptoms but not objective performance predicted prospective memory-related complaints. However, they do suggest that objective performance might hold greater predictive value in the absence of depressive symptoms, as this pattern was observed in a subgroup of the sample which reported fewer complaints. The regression model of Chin et al. (2014) also showed that depressive symptoms and self-focused attention (awareness of internal thoughts and information) scores overshadowed the small contribution of verbal learning scores to predicting SCCs in participants without cognitive impairment. Finally, Genziani et al. (2013) and Montejo et al. (2014) found depressive symptoms to be a greater predictor of SCCs than objective memory performance, although both made independent significant contributions to the regression models.

Collectively, these studies offer methodological strengths in that they employed a range of measures for assessing both subjective and objective memory, excluded participants with diagnosed cognitive disorders, and included those both with and without depression. In most cases participants were volunteers in the study and thus likely had interest in or concern about their memory. In one case (Balash et al. 2013). participants paid to be involved.

Consequently, the evidence from these studies that depressive symptoms is a stronger indicator of SCCs than objective performance is relatively reliable, but may be limited to those who are already concerned about their memory, whereas in the wider population other aetiological factors may also be important.

Evidence against the Influence of Depression By contrast, other studies found the link between SCCs and objective cognitive performance to be somewhat independent of depressive symptoms. Clément et al. (2008) administered the French-language Self Evaluation Questionnaire to volunteer participants, and found that participants' SCCS were not significantly associated with either objective functioning or depressive symptoms, which the authors interpreted as an indicator that this questionnaire might be particularly robust to the assessment of SCCs without also being confounded by depressive symptoms. Other work with both volunteer participants and random samples have found that objective cognitive function makes an additional significant contribution to a regression model of SCCs over and above that of affective symptoms (Martins et al. 2012; Parisi et al. 2011; Snitz et al. 2008; Trouton et al. 2006), that SCCs are associated with objective performance and not depressive symptoms at all (Lucas et al. 2016; Mewton et al. 2014), or that controlling for depressive symptoms makes very little difference to the association between SCCs and objective performance (Cook and Marsiske 2006). These latter studies generally used comprehensive assessments of both subjective and objective cognitive functioning.

Similar results have been reported in three larger-scale studies that also found persistent links between SCCs and objective performance despite the influence of depressive symptoms (Amariglio et al. 2011; Benito-León et al. 2010; Rouch et al. 2008). However, these studies also highlight possible limits to the association between SCCs and objective performance. Benito-León et al. (2010) showed that SCCs were related to specific areas of cognitive function more than others, such as verbal fluency, naming, and free recall, while Rouch et al. (2008) found associations with measures of executive functioning (Trail Making Test) and processing speed (Digit Symbol Substitution Test) and suggest these cognitive domains should be further explored in individuals with SCCs. Alternatively, only specific types of SCCs (particularly uncommon examples such as "getting lost") may be linked to cognitive functioning (Amariglio et al. 2011). Given the methodological strengths of large sample sizes and comprehensive assessment of objective cognitive functioning, these studies provide more weighty evidence that SCCs and objective performance are linked independently of depressive symptoms, although this may be limited to subsets of SCCs or domains of cognitive functioning. Results from Benito-León et al. (2010) and Rouch et al. (2008) also suggest that this link is present in more generalised population samples, as opposed to the evidence for affective aetiologies of SCCs in volunteer participants (discussed above).

Other Confounds As well as the influence of objective cognitive performance and depressive symptoms on SCCs, other studies have illuminated the impact of additional factors. First considering demographic variables, SCCs are generally more frequent in women than men (Brucki and Nitrini 2009; Lucas et al. 2016; Martins et al. 2012, although Tomita et al. (2014) have found that the link between SCCs and objective cognitive functioning was specific to males (whereas in females SCCs were linked to affective measures). Further, Merema et al. (2012) found the SCC-objective performance link was subject to the effects of age and pre-morbid IQ. SCCs also tend to be positively related to education level (Lucas et al. 2016), and this effect can confound the relationship between SCCs and objective performance (Genziani et al. 2013; van Oijen et al. 2007). However, SCCs do not appear to be related to employment status (Rijs et al. 2013).

Second, specific cognitive variables other than memory functioning have been uniquely linked to SCCs. As mentioned earlier, Benito-León et al. (2010) and Rouch et al. (2008) found links with measures of processing speed, executive functioning, and language measures. In addition, Mol et al. (2006) found SCCs were linked to slower processing speed but not memory performance, even after controlling for demographic and affective variables. However, Stenfors et al. (2013) suggest that processing speed differences may not explain SCCs, but instead they are related to difficulties in completing tasks that place high demands on cognitive resources. Other studies also support explanations relating to cognitive demands. Trouton et al. (2006) found that the relationship between SCCs and objective performance was strongest for participants with high levels of social activity, and interpret this factor as a practical indicator of cognitive demands in everyday life. Similarly, Martins et al. (2012) suggest that maintaining regular social interaction may prevent language-related SCCs such as word-finding difficulties and memory for proper names (although Genziani et al. 2013 provides results to the contrary). Alternatively, links between subjective and objective function may only exist for cognitive subgroups. A population-based study by Park et al. (2007) found that the degree of objective performance itself influenced the link with SCCs – SCCs and objective performance were associated only in those participants without cognitive impairment, and not in those with cognitive impairment. Similarly, Fernández-Blázquez et al. (2016) found that the relationship between SCCs and objective performance was stronger for participants with a range of cognitive complaints than those with memory complaints alone.

Thirdly, psychological factors other than depressive symptoms also display unique influences in some cases. While broad measures of psychological symptoms tend to be strongly associated with SCCs (Brucki and Nitrini 2009; Mewton et al. 2014), more specific constructs also exhibit influences. For example, Balash et al. (2013) found a significant association between anxiety and SCCs, although this was weak by absolute standards (Cohen 1988) and smaller than the association with depression. Cooper et al. (2011) also found anxiety

and somatic symptoms were associated with SCCs (along with depressive symptoms). Sims et al. (2011) highlight the importance of perceived stress and an externalised locus of control in explaining SCCs, and Dux et al. (2008) found that anxiety sensitivity affects the degree of congruence between subjective and objective memory measures. Similarly, personality traits such as neuroticism and self-directedness are also correlated with SCCs (Pearman et al. 2014; Rönnlund et al. 2011). Other researchers suggest that age-related stereotypes and perceptions of one's own age may influence SCCs (Langlois and Belleville 2014; Pearman et al. 2014), and use of compensatory strategies may confound their relationship with performance (Langlois and Belleville 2014).

Finally, the vulnerability of self-reports to failures of the cognitive abilities in question (i.e., forgetting to report memory difficulties) may limit the strength of any associations with objective functioning. Instead, reports may be more reliable when elicited from other people. For example, Juncos-Rabadan et al. (2012) have found that memory difficulties were linked to objective performance only when they were elicited from an informant, not the participant themselves. Buelow et al. (2014), Gavett et al. (2011), and Ramlall et al. (2013) also found informant reports to have greater predictive validity than self-reports, particularly for participants with some degree of objective impairment. The relevance of formal assessments to everyday difficulties may also limit findings. Langlois and Belleville (2014) highlight that the validity of laboratory-based tasks might be limited when compared to the everyday difficulties described in SCCs, and Lee et al. (2016) show evidence that ecologically valid tasks (such as those relating to prospective memory) can be more closely associated with SCCs than performance on more traditional measures of objective memory such as memory for word lists.

Absence of Evidence for a Link between SCCs and Objective Performance While all the studies discussed thus far have found some evidence for a link between SCCs and objective performance (whether it is related to other variables or independent of them), still others have found evidence to the contrary. Mendes et al. (2008) found no link between SCCs and objective performance across a wide range of age brackets, and instead SCCs were predicted only by depressive symptoms. Minett et al. (2008) found that SCCs were not associated with performance on neuropsychological tests of language, attention, or memory and learning, except for that on a category fluency task. They suggest that this pattern could reflect greater functional impact of verbal semantic fluency than other cognitive difficulties. Ultimately however, Minett et al. (2008) concluded that the clinical validity of SCCs for detecting objective performance was poor. Similar results have also been reported in other volunteer samples (Caramelli and Beato 2008; Shmotkin et al. 2013 and a larger sample by Buckley et al. (2013). These studies were usually limited in either their assessment of SCCs (Buckley et al. 2013; Caramelli and Beato 2008; Minett et al. 2008) or objective performance (Shmotkin et al. 2013), which may account for the lack of associations observed.

Summary Overall, cross-sectional studies included in this review tended to find limited support for a link between SCCs and concurrent objective performance. Links between SCCs and depressive symptoms were strong, and the influence of other cognitive and psychological variables are less well investigated but offer promising avenues for further research.

Studies that didn't find a link between subjective and objective cognition at all were few in number and vulnerable to limitations in their assessments of either subjective or objective functioning. However, some studies that did find a link between SCCs and objective functioning were also limited by their assessment methods and omission of important confounds such as depressive symptoms.

Stronger evidence comes from more methodologically robust studies, that tended to find evidence that SCCs are associated with depressive symptoms or objective cognitive functioning. A number of studies found that SCCs were more closely related to depressive symptoms than objective performance, which may indicate affective aetiologies of SCCs. That samples were also often limited to volunteer participants also supports this explanation. Such selection biases limit the external validity of conclusions, however they offer an important insight into the very people for whom the distress associated with SCCs causes them to seek help. Nevertheless, studies that used population-based samples still tended to find that SCCs and objective performance were linked independently of depressive and other affective symptoms, which suggests the predictive value of SCCs is not restricted to only "worried well" groups, but indicative of a more general relationship that might instead be confounded by methodological choices. In these studies, the SCC-objective performance link was instead shown to be specific to certain domains of cognitive functioning (Benito-León et al. 2010; Rouch et al. 2008) and perhaps only among participants who do not meet criteria for cognitive impairment (Park et al. 2007). Consequently, discrepant results may be due to variations in the measures used to assess objective performance, and therefore direct comparisons between various measures of objective performance and their respective associations with SCCs are warranted.

Suggestions for the role of other factors have also been found, with limited evidence (often from a single study) for the influence of other cognitive and psychological variables, as well as more consistent findings that SCCs are associated with demographic factors of female gender, older age, and more education.

Discussion

Previous reviews of literature concerning the value of SCCs for predicting objective performance have concluded both that SCCs can be a valid indicator of cognitive decline, particularly in old-older adults and those with high levels of education (Jonker et al. 2000), and that SCCs are not a consistent indicator of cognitive impairment (Reid and MacLullich 2006). The current review updates evidence about the relationship between SCCs and objective performance from studies conducted since 2006, provides a meta-analysis of this relationship, and a narrative review of moderator variables.

Fifty studies were included in the primary meta-analysis, which showed a small but significant correlation between subjective and objective cognitive function, where poorer performance on cognitive tests was associated with greater frequency or severity of subjective cognitive complaints. This finding aligns with the most recent meta-analysis on this topic from Crumley et al. (2014). However, the studies included in the current review were highly heterogeneous and showed some potential influence of publication bias. Heterogeneity was reduced somewhat in subgroup analyses (most strongly when restricted to memory measures only) but still remained high overall. These limitations mean that such factors need to be taken into account when interpreting the results.

Systematic review of the included studies suggested that evidence for links between SCCs and objective cognitive function, as well as SCCs and depressive symptoms, were more robust than those which showed no association between SCCs and cognitive function. In particular, many studies were limited by brief assessments of either SCCs or objective cognitive function. Meta-analysis of subgroups indicated a similarly high level of heterogeneity among 18 studies which used global measures of SMC function as the overall result, whereas those that used specific examples of memory difficulties or a mix of the two types were more homogeneous.

Meta-analyses of other subgroups also tended to show small but significant relationships between SCCs and cognitive functioning, however systematic review of the included studies at a more detailed level provided suggestions for factors that contribute to the heterogeneity among studies. For example, some evidence summarised here suggests that in particular groups (e.g., the "worried well" that tend to comprise volunteer samples), SCCs mostly likely reflect depressive symptoms, however in general populations the link may exist independently of depressive symptoms. SCCs were also found to be related to particular cognitive domains (such as memory, executive functioning, and processing speed).

One proposed interpretation for these findings is that SCCs might lead to later objective performance when compensatory strategies are absent or ineffective. This understanding of SCC aetiology proposes that memory problems which develop with age can be divided into two groups: those which are initially problematic but later are effectively managed with compensation strategies and have little functional impact, and those which remain problematic in the absence of effective compensation. Current assessments of SCCs may address only one of these types of memory concerns, and which type may differ between individuals (depending on whether they report difficulties which have occurred at some point or those which have continuing functional impact). The former type of memory difficulties may bear little relation to current functioning, while for the latter type of memory concerns, the absence of compensation, may explain associations between SCCs and other variables such as depressive symptoms (failure to develop effective compensation may lead to depressive symptoms, or depressive symptoms may prevent effective compensation) and executive function abilities (participants with better executive functioning would be more likely to develop effective compensatory strategies through their problem-solving skills). Another possibility is that third-party factors give rise to both SCCs and other observed correlates. For example, beliefs about age-related declines in functioning may lead to both depressive symptoms and SCCs.

Other methodological aspects of the reviewed studies which could have affected the results obtained include wide variation in assessments of SCCs and objective performance across studies, and in particular assessment of SCCs often being limited to a single yes-no question not yet validated as an assessment tool. Brief assessments introduce greater error into measures, and in particular studies that used single yes-no questions as measures of SCCs are likely to be highly vulnerable to this source of error. Reid and MacLullich (2006) also discussed the lack of validated assessment of SCCs, as well as variation across studies in the measurement of cognitive function and criteria defining cognitive decline or impairment. Here, a pattern of comprehensive SCC assessment was found to co-occur with findings that SCCs and were independently linked with both objective performance and depressive symptoms, which suggests that assessment shortcomings confound our understanding of the interplay between depression, SCCs, and objective performance. Recent progress has been made in this area, with Rabin et al. (2015) offering recommendations for future assessment of SCCs based on a review of numerous examples in the literature. Notably, their criteria suggest the use of specific examples rather than global questions regarding SMCs, which is supported by the current finding of less heterogeneity among the studies which used specific items.

Another issue raised in previous reviews on this topic concerns how the context in which studies are undertaken might influence the results, with community-based samples of older participants tending to find stronger evidence for the predictive value of SCCs than those with younger participants (Jonker et al. 2000). Here, the evidence did offer some support for the assertion that SCCs reported by younger volunteer

samples may be related to psychological rather than cognitive factors (Balash et al. 2013; Chin et al. 2014; Montejo et al. 2014).

Of the psychological factors examined, depressive symptoms appear to have the greatest influence. Jonker et al. (2000) concluded that this was due to the lack of cognitive impairment in younger samples, meaning the relative influence of depressive symptoms was greater than in older samples. Reid and MacLullich (2006) also agreed that depressive symptoms likely play a significant role in accounting for the SCC-objective performance link, but suggest that depressive symptoms may result from SCCs rather than cause them. Here, depressive symptoms were also often linked to SCCs and objective performance; however many methodologically strong studies also found that SCCs and objective performance were independently linked even when depression was controlled for, suggesting that depressive symptoms likely have a primary, but not solitary, role in the development of SCCs.

Other variables highlighted in a smaller number of studies included the role of informant reports of memory difficulties, which in some studies had greater predictive power for participants' objective performance than did their own self-reports (Buelow et al. 2014; Gavett et al. 2011; Juncos-Rabadan et al. 2012; Ramlall et al. 2013). Demographic variables also showed some particular relationships, such as SCCs in women being cross-sectionally linked to psychological factors, while in men they were related to cognitive performance (Tomita et al. 2014). Such discrepancies could reflect the influence of study design on the findings, or other factors such as differing types of inaccuracies between genders. For example, recent work has found that men tend to overestimate their memory functioning whereas women underestimate it (Rickenbach et al. 2015).

Of note is the relative absence of findings regarding the influence of anxiety and neuroticism, which have been highlighted in previous reviews. Only Balash et al. (2013) have noted a significant association between SCCs and anxiety, which was overshadowed by a stronger link with depression. Clinical practice would suggest a greater prevalence of anxiety symptoms among people with SCCs, and indeed work prior to the period covered here supports this (Derouesné et al. 1999; Lautenschlager et al. 2005; Sinoff and Werner 2003). Neuroticism was a significant predictor of later SCCs in only one study reviewed here (Pearman et al. 2014), but again similar relationships have also been found in work prior to 2006 (Kliegel et al. 2005).

These findings suggest anxiety and neuroticism could have significant explanatory power in the relationship between SCCs and objective performance, yet have been relatively neglected in recent research. Similarly, knowledge about one's own genetic risk factors for age-related cognitive disorders such as Alzheimer's disease has previously been shown to influence both subjective and objective memory (Lineweaver et al. 2014; Suhr and Kinkela 2007), although such variables were not explored in any studies that met inclusion criteria for this review. Dementia-related worry has also been shown to interact with cognitive impairment to predict SCCs (Kinzer and Suhr 2016). Further investigation of this range of psychological variables is warranted in order to better understand the nature and extent of their role.

Constructs related to SCCs, such as memory self-efficacy (a person's beliefs about their own memory ability), are also not often examined concurrently, and may offer additional insights into the clinical utility of SCCs. For example, a recent meta-analysis found memory self-efficacy and memory performance are significantly positively correlated (Beaudoin and Desrichard 2011), and thus investigation of the relationship between memory self-efficacy and SCCs may shed further light on both of their associations with objective performance. Compensatory strategies again offer a possible explanation here. Greater memory self-efficacy could be reasonably hypothesised to lead to increased employment of compensatory strategies, which in turn might lead to better memory performance as well as fewer ongoing SCCs.

Suggestions for Future Research

In agreement with Jonker et al. (2000) and Reid and MacLullich (2006), there is still evidence that inconsistency and lack of validation among assessment procedures used among studies influences the results obtained. Consequently, explicit investigation of how these different procedures (e.g., single yes-no questions vs. multiple questions vs. questionnaires) influence SCC reports would be of great value (see Burmester et al. 2015 for a recent exploration of this question). Similarly, further investigation or explicit review of informant reports as indicators of cognitive impairment could be valuable, as only a subset of those studies which have assessed informant reports happened to meet the inclusion criteria for this review. Further, the development of a "gold standard" measure (as noted by Rabin et al. 2015) for assessing SCCs would also be helpful in establishing some consistency across studies.

Following this progress, further analysis of the links between SCCs and objective performance among differing populations could be assessed more robustly, and the influence of psychological variables better understood. In particular, the role of depressive symptoms appears to be of greatest importance and warrants further investigation, as does that of anxiety, demographic variables and informant reports. Finally, refinement of the procedures used to assess objective performance would be advantageous due to the wide variation noted here, especially comparing the relationships between SCCs and various measures of objective performance.

Direct investigation of the compensation aetiology of SCCs as proposed here is necessary. This could initially consist of assessment of SCCs, objective performance, executive functioning and compensatory strategies in a within-subjects design. Measures of compensatory strategies such as the Memory Compensation Questionnaire (Dixon et al. 2001) could be valuable here, as well as SCC measures in which participants are prompted to distinguish between memory difficulties for which they have effective compensatory strategies and those which still cause functional impairment. The compensation theory of SCCs predicts that executive functioning measures would mediate the relationship between SCCs and objective performance, with lower numbers of SCCs being related to greater executive functioning abilities (and effective use of compensatory strategies) and lower rates of objective performance. Investigations of such hypotheses are also warranted.

Clinical Implications

The primary point of relevance for clinical practice offered by this review is that the value of SCCs for indicating objectively detectable cognitive impairment is very small at best. Clinicians are advised that depressive symptoms are more likely to be related to SCCs than actual impairment, and further investigations should proceed as such. However in doing so, we stress the importance of validating patients' concerns without dismissing SCCs as solely mood-related symptoms. Instead, it is recommended that the limited link between SCCs and actual performance is discussed with a concurrent emphasis on developing compensatory strategies that are effective for the difficulties experienced, regardless of their aetiology.

One primary explanation for the varying results reviewed here related to the impact of SCC assessments on the results obtained. Consequently, clinicians should be aware of how their chosen method of assessing SCCs might influence the reports gathered (at least until progress is made towards establishing a 'gold standard' measure as mentioned above). In particular, single question assessments requiring only a yes-no response (e.g., "Do you have problems with your memory?") were alarmingly common, and associated with greater influences of confounding variables such as affective aetiologies. If such questions continue to be used in practice, it is recommended that at most they function only as a screen for more detailed assessment, much in the manner of screens for objective cognitive functioning such as the MMSE. More detailed methods are recommended for clinical use in order to better understand which SCCs which are most salient for an individual and what possible aetiologies different SCCs might be associated with. Open-ended, non-prescriptive questions are also recommended because the internal nature of SCCs means they are likely to be best reflected when descriptions are generated by the individual themselves rather than responding to a pre-conceived set of particular questions (see also Burmester et al. 2015).

The compensation theory of SCCs proposed here suggests that clinical assessments would also be well advised to include measures of both the presence of various SCCs as well as their functional impact. This distinction would allow clinicians to target SCCs with the most distressing functional consequences and assess the presence of SCCs that may have little functional impact due to use of effective compensation strategies.

Limitations

The findings of this review are subject to limitations. These include questions about the external validity of findings – given that only 50 articles of 2221 initial search results met inclusion criteria, there might be limits to the degree to which findings can be generalised to the full domain. However, we would argue that this pattern reflects the broad search terms used initially, meaning that approximately three-quarters of the initial articles were either duplicates or did not actually examine the topic of interest. The advantage of using broad initial search strategies also meant that relevant articles were less likely to be missed.

Secondly, the construct of SCCs has previously been described by other terms (e.g., meta-memory, subjective cognitive complaints, memory self-efficacy, memory beliefs, forgetfulness, everyday memory failures), which may have meant relevant articles that used these terms were not included in the review. However, SCCs is the predominant term for this phenomenon and is that which is associated with diagnostic criteria for MCI (e.g., American Psychological Association 2013). Other expressions usually refer to conceptually related, but different, phenomena, and thus inclusion of these terms would have conflated SCCs with other constructs and posed a greater threat to internal validity.

As with any review, publication bias influences which findings are available for inclusion. Here, results indicated some potential influence of publication bias, however the high degree of heterogeneity observed means that estimates of publication bias are of limited accuracy. It is also noted that, in this topic area, the abundance of mixed results could be an indicator that the 'file-drawer' problem may have less influence than in other fields in which published findings are dominated by significant effects.

The existing heterogeneity among studies, inconsistency of results in this area, and considerable variation in the measures of SCCs, objective performance, confounding factors, and in the samples used (with varying exclusion criteria) also contributed to the caution with which conclusions can be drawn. Give that the current status of this field is characterised by highly mixed findings, the causes of which are not understood, combining results in a meta-analysis might obscure

important factors and thus more detailed examinations of the particular methodological factors outlined earlier are warranted in order to first produce more homogeneous studies and disentangle the roles of the numerous moderating variables identified here.

Conclusions

Since 2006, cross-sectional studies examining the link between SCCs and objective performance suggest that this association is significant but small, and likely of less importance than that between SCCs and affective symptoms. Future research that clarifies the influence of assessment methods on the results obtained is likely to be of great value in understanding the nature of how SCCs reflect current or future cognitive impairments. One possible explanation of the mixed findings across studies may be that SCCs reflect only difficulties which have not been successfully ameliorated through compensation strategies, and thus further investigation of this theory is also warranted.

Compliance with Ethical Standards

Funding This study was partially funded by a HOPE-Selwyn Foundation Scholarship for Research on Ageing.

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval For this type of study formal consent is not required. This article does not contain any studies with human participants or animals performed by any of the authors.

References

Amariglio, R. E., Townsend, M. K., Grodstein, F., Sperling, R. A., & Rentz, D. M. (2011). Specific subjective memory complaints in older persons may indicate poor cognitive function. *Journal of the American Geriatrics Society, 59*(9), 1612–1617. doi:10.1111/j.1532-5415.2011.03543.x.

Amariglio, R. E., Becker, J. A., Carmasin, J., Wadsworth, L. P., Lorius, N., Sullivan, C., Maye, J. E., et al. (2012). Subjective cognitive complaints and amyloid burden in cognitively normal older individuals. *Neuropsychologia, 50*(12), 2880–2886. doi:10.1016/j.neuropsychologia.2012.08.011.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Apolinario, D., Miranda, R. B., Suemoto, C. K., Magaldi, R. M., Busse, A. L., Soares, A. T., da Costa Lopes, L., et al. (2012). Characterizing spontaneously reported cognitive complaints: the development and reliability of a classification instrument. *International Psychogeriatrics, 25*(01), 157–166. doi:10.1017/S1041610212001494.

Balash, Y., Mordechovich, M., Shabtai, H., Giladi, N., Gurevich, T., & Korczyn, A. D. (2013). Subjective memory complaints in elders: depression, anxiety, or cognitive decline? *Acta Neurologica Scandinavica, 127*(5), 344–350. doi:10.1111/ane.12038.

Beaudoin, M., & Desrichard, O. (2011). Are memory self-efficacy and memory performance related? A meta-analysis. *Psychological Bulletin, 137*(2), 211–241. doi:10.1037/a0022106.

Begum, A., Morgan, C., Chiu, C. C., Tylee, A., & Stewart, R. (2012). Subjective memory impairment in older adults: aetiology, salience and help seeking. *International Journal of Geriatric Psychiatry, 27*(6), 612–620. doi:10.1002/gps.2760.

Benito-León, J., Mitchell, A. J., Vega, S., & Bermejo-Pareja, F. (2010). A population-based study of cognitive function in older people with subjective memory complaints. *Journal of Alzheimer's Disease, 22*, 159–170. doi:10.3233/JAD-2010-100972.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. (2010). A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research Synthesis Methods, 1*, 97–111. doi:10.1002/jrsm.12.

Brucki, S. M. D., & Nitrini, R. (2009). Subjective memory impairment in a rural population with low education in the Amazon rainforest: an exploratory study. *International Psychogeriatrics, 21*(1), 164–171. doi:10.1017/S1041610208008065.

Buckley, R., Saling, M. M., Ames, D., Rowe, C. C., Lautenschlager, N. T., Macaulay, S. L., Martins, R. N., et al. (2013). Factors affecting subjective memory complaints in the AIBL aging study: biomarkers, memory, affect, and age. *International Psychogeriatrics, 25*(8), 1307–1315. doi:10.1017/S1041610213000665.

Buelow, M. T., Tremont, G., Frakey, L. L., Grace, J., & Ott, B. R. (2014). Utility of the cognitive difficulties scale and association with objective test performance. *American Journal of Alzheimer's Disease and Other Dementias, 29*(8), 755–761. doi:10.1177/1533317514539032.

Burmester, B., Leathem, J., & Merrick, P. (2015). Assessing subjective memory complaints: a comparison of spontaneous reports and structured questionnaire methods. *International Psychogeriatrics, 27*(1), 61–77. doi:10.1017/S1041610214001161.

Calabria, M., Manenti, R., Rosini, S., Zanetti, O., Miniussi, C., & Cotelli, M. (2011). Objective and subjective memory impairment in elderly adults: a revised version of the everyday memory questionnaire. *Aging Clinical and Experimental Research, 23*, 67–73. doi:10.1007/BF03324954.

Caramelli, P., & Beato, R. G. (2008). Subjective memory complaints and memory performance in a sample of healthy elderly. *Dementia & Neuropsychologia, 2*(1), 42–45 Retrieved from http://demneuropsy.com.br/imageBank/PDF/dnv02n01a08.pdf.

Chin, J., Oh, K. J., Seo, S. W., & Na, D. L. (2014). Are depressive symptomatology and self-focused attention associated with subjective memory impairment in older adults? *International Psychogeriatrics, 26*(4), 573–580. doi:10.1017/S104161021300241X.

Clément, F., Belleville, S., & Gauthier, S. (2008). Cognitive complaint in mild cognitive impairment and Alzheimer's disease. *Journal of the International Neuropsychological Society, 14*, 222–232. doi:10.1017/S1355617708080260.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cook, S., & Marsiske, M. (2006). Subjective memory beliefs and cognitive performance in normal and mildly impaired older adults. *Aging & Mental Health, 10*(4), 413–423. doi:10.1080/13607860600638487.

Cooper, C., Bebbington, P., Lindesay, J., Meltzer, H., McManus, S., Jenkins, R., & Livingston, G. (2011). The meaning of reporting forgetfulness: a cross-sectional study of adults in the English 2007 adult psychiatric morbidity survey. *Age and Ageing, 40*(6), 711–717. doi:10.1093/ageing/afr121.

Crumley, J. J., Stetler, C. A., & Horhota, M. (2014). Examining the relationship between subjective and objective memory performance in older adults: a meta-analysis. *Psychology and Aging, 29*(2), 250–263. doi:10.1037/a0035908.

de Jager, C. A., Schrijnemaekers, A. C. M. C., Honey, T. E. M., & Budge, M. M. (2009). Detection of MCI in the clinic: evaluation of the sensitivity and specificity of a computerised test battery, the Hopkins verbal learning test and the MMSE. *Age and Ageing, 38*(4), 455–460. doi:10.1093/ageing/afp068.

Derouesné, C., Lacomblez, L., Thibault, S., & LePoncin, M. (1999). Memory complaints in young and elderly subjects. *International Journal of Geriatric Psychiatry, 14*, 291–301. doi:10.1002/(SICI)1099-1166(199904)14:4<291::AID-GPS902>3.0.CO;2-7.

Dixon, R., de Frias, C., & Bäckman, L. (2001). Characteristics of self-reported memory compensation in older adults. *Journal of Clinical and Experimental Neuropsychology, 23*(5), 650–661. doi:10.1076/jcen.23.5.650.1242.

Dux, M. C., Woodard, J. L., Calamari, J. E., Messina, M., Arora, S., Chik, H., & Pontarelli, N. (2008). The moderating role of negative affect on objective verbal memory performance and subjective memory complaints in healthy older adults. *Journal of the International Neuropsychological Society, 14*, 327–336. doi:10.1017/S1355617708080363.

Fernández-Blázquez, M. A., Ávila-Villanueva, M., Maestú, F., & Medina, M. (2016). Specific features of subjective cognitive decline predict faster conversion to mild cognitive impairment. *Journal of Alzheimer's Disease, 52*(1), 271–281. doi:10.3233/JAD-150956.

Gavett, R., Dunn, J. E., Stoddard, A., Harty, B., & Weintraub, S. (2011). The cognitive change in women study (CCW): informant ratings of cognitive change but not self ratings are associated with neuropsychological performance over three years. *Alzheimer Disease & Associated Disorders, 25*(4), 305–311. doi:10.1097/WAD.0b013e31820d8652.

Genziani, M., Stewart, R., Béjot, Y., Amieva, H., Artero, S., & Ritchie, K. (2013). Subjective memory impairment, objective cognitive functioning and social activity in French older people: findings from the three cities study. *Geriatrics & Gerontology International, 13*(1), 139–145. doi:10.1111/j.1447-0594.2012.00873.x.

Grambaite, R., Hessen, E., Auning, E., Aarsland, D., Selnes, P., & Fladby, T. (2013). Correlates of subjective and mild cognitive impairment: depressive symptoms and CSF biomarkers. *Dementia and Geriatric Cognitive Disorders Extra, 3*(1), 291–300. doi:10.1159/000354188.

Hohman, T. J., Beason-Held, L. L., Lamar, M., & Resnick, S. M. (2011). Subjective cognitive complaints and longitudinal changes in memory and brain function. *Neuropsychology, 25*(1), 125–130. doi:10.1037/a0020859.

Jacinto, A., Brucki, S., Porto, C., Martins, M., & Nitrini, R. (2014). Subjective memory complaints in the elderly: a sign of cognitive impairment. *Clinics, 69*(3), 194–197. doi:10.6061/clinics/2014(03)09.

Jonker, C., Geerlings, M. I., & Schmand, B. (2000). Are memory complaints predictive for dementia? A review of clinical and population-based studies. *International Journal of Geriatric Psychiatry, 15*, 983–991. doi:10.1002/1099-1166(200011)15:11<983::AID-GPS238>3.0.CO;2-5.

Juncos-Rabadan, O., Pereiro, A. X., Facal, D., Rodriguez, N., Lojo, C., Caamaño, J. A., Sueiro, J., et al. (2012). Prevalence and correlates of cognitive impairment in adults with SCCs in primary care centres. *Dementia and Geriatric Cognitive Disorders, 33*, 226–232. doi:10.1159/000338607.

Kinzer, A., & Suhr, J. A. (2016). Dementia worry and its relationship to dementia explosure, psychological factors, and subjective memory concerns. *Applied Neuropsychology: Adult, 23*(3), 196–204. doi:10.1080/23279095.2015.1030669.

Kliegel, M., Zimprich, D., & Eschen, A. (2005). What do subjective cognitive complaints in persons with aging-associated cognitive decline reflect? *International Psychogeriatrics, 17*(3), 499. doi:10.1017/S1041610205001638.

Lachman, M. E. (2004). Development in midlife. *Annual Review of Psychology, 55*(1), 305–331. doi:10.1146/annurev.psych.55.090902.141521.

Lachman, M. E., & Andreoletti, C. (2006). Strategy use mediates the relationship between control beliefs and memory performance for middle-aged and older adults. *Journal of Gerontology: Psychological Sciences, 61B*(2), 88–94 Retrieved from http://psychsocgerontology.oxfordjournals.org/content/61/2/P88.long.

Langlois, A. S., & Belleville, S. (2014). Subjective cognitive complaint in healthy older adults: identification of major domains and relation to objective performance. *Aging, Neuropsychology, and Cognition, 21*(3), 257–282. doi:10.1080/13825585.2013.795928.

Lautenschlager, N. T., Flicker, L., Vasikaran, S., Leedman, P., & Almeida, O. P. (2005). Subjective memory complaints with and without objective memory impairment: relationship with risk factors for dementia. *The American Journal of Geriatric Psychiatry, 13*(8), 731–734. doi:10.1097/00019442-200508000-00013.

Lee, S., Ong, B., Pike, K. E., Mullaly, E., Rand, E., Storey, E., Ames, D., et al. (2016). The contribution of prospective memory performance to the neuropsychological assessment of mild cognitive impairment. *The Clinical Neuropsychologist, 30*(1), 131–149. doi:10.1080/13854046.2015.1135983.

Lineweaver, T. T., Bondi, M. W., Galasko, D., & Salmon, D. P. (2014). Effect of knowledge of APOE genotype on subjective and objective memory performance in healthy older adults. *American Journal of Psychiatry, 171*, 201–208. doi:10.1176/appi.ajp.2013.12121590.

Lucas, H. D., Monti, J. M., McAuley, E., Watson, P. D., Kramer, A. F., & Cohen, N. J. (2016). Relational memory and self-efficacy measures reveal distinct profiles of subjective memory concerns in older adults. *Neuropsychology*. doi:10.1037/neu0000275.

Martins, I. P., Mares, I., & Stilwell, P. A. (2012). How subjective are subjective language complaints? *European Journal of Neurology, 19*(5), 666–671. doi:10.1111/j.1468-1331.2011.03635.x.

Mendes, T., Ginó, S., Ribeiro, F., Guerreiro, M., de Sousa, G., Ritchie, K., & de Mendonça, A. (2008). Memory complaints in healthy young and elderly adults: reliability of memory reporting. *Aging & Mental Health, 12*(2), 177–182. doi:10.1080/13607860701797281.

Mendonça, M. D., Alves, L., & Bugalho, P. (2016). From subjective cognitive complaints to dementia: who is at risk? A systematic review. *American Journal of Alzheimer's Disease and Other Dementias, 31*(2), 105–114. doi:10.1177/1533317515592331.

Merema, M. R., Speelman, C. P., Kaczmarek, E. A., & Foster, J. K. (2012). Age and premorbid intelligence suppress complaint–performance congruency in raw score measures of memory. *International Psychogeriatrics, 24*(3), 397–405. doi:10.1017/S1041610211001918.

Mewton, L., Sachdev, P., Anderson, T., Sunderland, M., & Andrews, G. (2014). Demographic, clinical, and lifestyle correlates of subjective memory complaints in the Australian population. *The American Journal of Geriatric Psychiatry, 22*(11), 1222–1232. doi:10.1016/j.jagp.2013.04.004.

Minett, T. S. C., Da Silva, R. V., Ortiz, K. Z., & Bertolucci, P. H. F. (2008). Subjective memory complaints in an elderly sample: a cross-sectional study. *International Journal of Geriatric Psychiatry, 23*(1), 49–54. doi:10.1002/gps.1836.

Mitchell, A. J., Beaumont, H., Ferguson, D., Yadegarfar, M., & Stubbs, B. (2014). Risk of dementia and mild cognitive impairment in older people with subjective memory complaints: meta-analysis. *Acta Psychiatrica Scandinavica, 130*(6), 439–451. doi:10.1111/acps.12336.

Mol, M., van Boxtel, M. P. J., Willems, D., & Jolles, J. (2006). Do subjective memory complaints predict cognitive dysfunction over time? A six-year follow-up of the Maastricht aging study. *International Journal of Geriatric Psychiatry, 21*(5), 432–441. doi:10.1002/gps.1487.

Mol, M., Carpay, M., Ramakers, I., Rozendaal, N., Verhey, F., & Jolles, J. (2007). The effect of perceived forgetfulness on quality of life in

older adults: a qualitative review. *International Journal of Geriatric Psychiatry, 22*(5), 393–400. doi:10.1002/gps.1686.

Montejo, P., Montenegro, M., Fernández, M. A., & Maestú, F. (2011). Subjective memory complaints in the elderly: prevalence and influence of temporal orientation, depression and quality of life in a population-based study in the city of Madrid. *Aging & Mental Health, 15*(1), 85–96. doi:10.1080/13607863.2010.501062.

Montejo, P., Montenegro, M., Fernández-Blázquez, M. A., Turrero-Nogués, A., Yubero, R., Huertas, E., & Maestú, F. (2014). Association of perceived health and depression with older adults' subjective memory complaints: contrasting a specific questionnaire with general complaints questions. *European Journal of Ageing, 11*(1), 77–87. doi:10.1007/s10433-013-0286-4.

Ossher, L., Flegal, K. E., & Lustig, C. (2013). Everyday memory errors in older adults. *Aging, Neuropsychology, and Cognition, 20*(2), 220–242. doi:10.1080/13825585.2012.690365.

Paradise, M. B., Glozier, N. S., Naismith, S. L., Davenport, T. A., & Hickie, I. B. (2011). Subjective memory complaints, vascular risk factors and psychological distress in the middle-aged: a cross-sectional study. *BMC Psychiatry, 11*(1), 108. doi:10.1186/1471-244X-11-108.

Parisi, J. M., Gross, A. L., Rebok, G. W., Saczynski, J. S., Crowe, M., Cook, S. E., Langbaum, J. B. S., et al. (2011). Modeling change in memory performance and memory perceptions: findings from the ACTIVE study. *Psychology and Aging, 26*(3), 518–524. doi:10.1037/a0022458.

Park, M. H., Min, J. Y., Min, H. Y., Lee, H. J., Lee, D. H., & Song, M. S. (2007). Subjective memory complaints and clinical characteristics in elderly Koreans: a questionnaire survey. *International Journal of Nursing Studies, 44*(8), 1400–1405. doi:10.1016/j.ijnurstu.2006.06.001.

Pearman, A., Hertzog, C., & Gerstorf, D. (2014). Little evidence for links between memory complaints and memory performance in very old age: longitudinal analyses from the berlin aging study. *Psychology and Aging, 29*(4), 828–842. doi:10.1037/a0037141.

Ponds, R. W. H. M., Van Boxtel, M. P. J., & Jolles, J. (2000). Age-related changes in subjective cognitive functioning. *Educational Gerontology, 26*(1), 67–81. doi:10.1080/036012700267402.

Rabin, L. A., Smart, C. M., Crane, P. K., Amariglio, R. E., Berman, L. M., Boada, M., Buckley, R. F., et al. (2015). Subjective cognitive decline in older adults: an overview of self-report measures used across 19 international research studies. *Journal of Alzheimer's Disease, 48*(1), S63–S86. doi:10.3233/JAD-150154.

Ramlall, S., Chipps, J., Bhigjee, A., & Pillay, B. (2013). Screening a heterogeneous elderly south African population for cognitive impairment: the utility and performance of the mini-mental state examination, six item screener, subjective memory rating scale and deterioration cognitive Observee. *African Journal of Psychiatry, 16*(6). doi:10.4314/ajpsy.v16i6.57.

Reid, L. M., & MacLullich, A. M. J. (2006). Subjective memory complaints and cognitive impairment in older people. *Dementia and Geriatric Cognitive Disorders*, (5–6), 471–485. doi:10.1159/000096295.

Reisberg, B., & Gauthier, S. (2008). Current evidence for subjective cognitive impairment (SCI) as the pre-mild cognitive impairment (MCI) stage of subsequently manifest Alzheimer's disease. *International Psychogeriatrics, 20*(1), 1–16. doi:10.1017/S1041610207006412.

Rickenbach, E. H., Agrigoroaei, S., & Lachman, M. E. (2015). Awareness of memory ability and change: (in) accuracy of memory self-assessments in relation to performance. *Journal of Population Ageing, 8*, 71–99. doi:10.1007/s12062-014-9108-5.

Rijs, K. J., Comijs, H. C., van den Kommer, T. N., & Deeg, D. J. H. (2013). Do employed and not employed 55 to 64-year-olds' memory complaints relate to memory performance? A longitudinal cohort study. *The European Journal of Public Health, 23*(6), 1013–1020. doi:10.1093/eurpub/cks159.

Rönnlund, M., Vestergren, P., Mäntylä, T., & Nilsson, L. G. (2011). Predictors of self-reported prospective and retrospective memory in a population-based sample of older adults. *The Journal of Genetic Psychology, 172*(3), 266–284. doi:10.1080/00221325.2010.538450.

Rouch, I., Anterion, C. T., Dauphinot, V., Kerleroux, J., Roche, F., Barthelemy, J. C., & Laurent, B. (2008). Cognitive complaints, neuropsychological performance and affective disorders in elderly community residents. *Disability & Rehabilitation, 30*(23), 1794–1802. doi:10.1080/09638280701667825.

Shmotkin, D., Eyal, N., Hazan, H., Shkolnik, T., Shorek, A., & Cohen-Mansfield, J. (2013). Between the subjective and the objective: how informative is subjective evaluation of memory among the old-old? *Clinical Gerontologist, 36*(4), 294–315. doi:10.1080/07317115.2013.788115.

Sims, R. C., Whitfield, K. E., Ayotte, B. J., Gamaldo, A. A., Edwards, C. L., & Allaire, J. C. (2011). Subjective memory in older African Americans. *Experimental Aging Research, 37*(2), 220–240. doi:10.1080/0361073X.2011.555640.

Sinoff, G., & Werner, P. (2003). Anxiety disorder and accompanying subjective memory loss in the elderly as a predictor of future cognitive decline. *International Journal of Geriatric Psychiatry, 18*(10), 951–959. doi:10.1002/gps.1004.

Snitz, B. E., Morrow, L. A., Rodriguez, E. G., Huber, K. A., & Saxton, J. A. (2008). Subjective memory complaints and concurrent memory performance in older patients of primary care providers. *Journal of the International Neuropsychological Society, 14*, 1004–1013. doi:10.1017/S1355617708081332.

Snitz, B. E., Small, B. J., Wang, T., Chang, C. C. H., Hughes, T. F., & Ganguli, M. (2015). Do subjective memory complaints lead or follow objective cognitive change? A five-year population study of temporal influence. *Journal of the International Neuropsychological Society, 21*, 732–742. doi:10.1017/S1355617715000922.

Steinberg, S. I., Negash, S., Sammel, M. D., Bogner, H., Harel, B. T., Livney, M. G., McCoubrey, H., et al. (2013). Subjective memory complaints, cognitive performance, and psychological factors in healthy older adults. *American Journal of Alzheimer's Disease and Other Dementias, 28*(8), 776–783. doi:10.1177/1533317513504817.

Stenfors, C. U. D., Marklund, P., Hanson, L. L. M., Theorell, T., & Nilsson, L. G. (2013). Subjective cognitive complaints and the role of executive cognitive functioning in the working population: a case-control study. *PloS One, 8*(12), e83351. doi:10.1371/journal.pone.0083351.t004.

Stewart, R. (2012). Mild cognitive impairment: the continuing challenge of its "real-world" detection and diagnosis. *Archives of Medical Research, 43*(8), 609–614. doi:10.1016/j.arcmed.2012.10.011.

Suhr, J. A., & Kinkela, J. H. (2007). Perceived threat of Alzheimer disease (AD): the role of personal experience with AD. *Alzheimer Disease & Associated Disorders, 21*(3), 225–231.

Tomita, T., Sugawara, N., Kaneda, A., Okubo, N., Iwane, K., Takahashi, I., Kaneko, S., et al. (2014). Sex-specific effects of subjective memory complaints with respect to cognitive impairment or depressive symptoms. *Psychiatry and Clinical Neurosciences, 68*(3), 176–181. doi:10.1111/pcn.12102.

Trouton, A., Stewart, R., & Prince, M. (2006). Does social activity influence the accuracy of subjective memory deficit? Findings from a British community survey. *Journal of the American Geriatrics Society, 54*(7), 1108–1113. doi:10.1111/j.1532-5415.2006.00800.x.

van Oijen, M., de Jong, F. J., Hofman, A., Koudstaal, P. J., & Breteler, M. M. B. (2007). Subjective memory complaints, education, and risk of Alzheimer's disease. *Alzheimer's & Dementia, 3*(2), 92–97. doi:10.1016/j.jalz.2007.01.011.

Waldorff, F. B., Siersma, V., Vogel, A., & Waldemar, G. (2012). Subjective memory complaints in general practice predicts future dementia: a 4-year follow-up study. *International Journal of Geriatric Psychiatry, 27*(11), 1180–1188. doi:10.1002/gps.3765.

Zeintl, M., Kliegel, M., Rast, P., & Zimprich, D. (2006). Prospective memory complaints can be predicted by prospective memory performance in older adults. *Dementia and Geriatric Cognitive Disorders, 22*(3), 209–215. doi:10.1159/000094915.

Zlatar, Z. Z., Moore, R. C., Palmer, B. W., Thompson, W. K., & Jeste, D. V. (2014). Cognitive complaints correlate with depression rather than concurrent objective cognitive impairment in the successful aging evaluation baseline sample. *Journal of Geriatric Psychiatry and Neurology, 27*(3), 181–187. doi:10.1177/0891988714524628.