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The "other" relationships of self-assessed intelligence: A meta-analysis

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ABSTRACT

The primary goal of the current article is to "take stock" of the "other" relationships of self-assessed intelligence (SAI). The current article groups the relationships of SAI into four categories: constructs associated with intelligence (openness, emotional intelligence), tendencies and opportunities to develop intelligence (conscientiousness, education, age, SES, prior IQ test experience), constructs associated with biased self-assessments (extraversion, neuroticism, narcissism, honesty-humility, race), and positive states and life achievements (positive self-regard, psychological well-being, academic achievement). The meta-analytic results demonstrate that almost all variables from these four categories significantly relate to SAI, with the exception of prior IQ test experience. These relationships are also consistent when accounting for psychometric intelligence, and no studied moderator variables consistently influence the magnitude of these results.

1. Introduction

In research, self-assessed intelligence[4] (SAI) is most often treated as an indicator of perceptual bias, which is reflected in two recent meta-analyses performed on SAI. Freund and Kasten (2012) meta-analytically showed that SAI has only a moderate relationship with psychometric intelligence (*corrected* $\bar{r} = 0.33$). The authors argued that other factors, such as the measurement method and reference group, have a large influence on the accuracy of these ratings, and they provided practical suggestions for improved self-assessments. Similarly, Syzmanowicz and Furnham (2011) meta-analytically showed that males assess their intelligence at a significantly higher level than females (*weighted* $\bar{d} = 0.37$), and these authors argued that gender differences in SAI may be due to the differing socialization of males and females. Males are encouraged to be bold and outgoing, whereas females are encouraged to be passive and submissive – at least in many western cultures (Furnham, Fong, & Martin, 1999; Furnham, 2001). This results in a "male hubris, female humility" effect (Furnham, 2001, p. 101). These two meta-analyses represent the majority of extant research on SAI, especially the treatment of SAI as an indicator of perceptual bias with less consideration for its impact on human functioning.

The current article argues that SAI is indeed an indicator of perceptual bias, but it is more central to the self than commonly suggested. We propose that SAI is directly linked to many frequently-studied individual differences, and the relationships of SAI with these individual differences may be even larger than the relationship between SAI and psychometric intelligence. SAI's association with narcissism and honesty-humility is clear, but we likewise suggest that SAI is related to many other personality (e.g. Big Five) and demographic characteristics (e.g. age and ethnicity). We also argue that SAI is linked to positive self-regard and psychological well-being, which could suggest that the ramifications of possessing poor SAI is more detrimental than often considered. If so, then future research would be needed to investigate any causal effects and possibly develop interventions to reduce poor SAI in vulnerable populations.

To support these assertions, the current article performs a meta-analysis on the "other" relationships of SAI beyond psychometric intelligence and gender. Social cognitive theory is used to provide theoretical support for these relationships (Bandura, 1986, 2001, 2011; Compeau, Higgins, & Huff, 1999), in which the relationships of SAI are proposed to arise from four domains: associations with intelligence (openness, emotional intelligence), tendencies and opportunities to develop intelligence (conscientiousness, education, age, socioeconomic status, prior IQ

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[4] Also called self-reported intelligence, self-evaluated intelligence, and self-estimated intelligence.

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test experience), associations with biased self-assessments (extraversion, neuroticism, narcissism, honesty-humility, ethnicity), and positive states and life achievements (positive self-regard, psychological well-being, academic achievement). It should be highlighted that these studied relationships arise from many sources, including individual differences, demographic characteristics, well-being, and others. We also control for psychometric intelligence when testing many of these relationships, providing evidence that these relations are substantive and not due to common associations with actual intelligence. By studying these varied relationships, we provide evidence that SAI plays a more central role in the self than commonly suggested, and thereby SAI may have a larger relationship with well-being and human functioning than often believed.

Further, many of these relationships were studied as ancillary effects in their original sources. That is, SAI was often used as a control and/or proxy variable in the original sources, and these relationships were not discussed as in-depth as the focal relationships and/or only discussed as an indicator of actual intelligence. For this reason, while meta-analyses are built upon prior work, the current meta-analysis provides novel insights because it draws attention to these overlooked relationships – perhaps for the first time in many cases. Likewise, a meta-analysis or review has yet to "take stock" of these varied relationships, and many basic questions still remain (i.e. frequency of study, strength of relationship). Therefore, the current meta-analysis not only highlights relationships that may be important for future research and theorizing, but it also unifies current knowledge on these relationships to expedite future efforts.

2. Background

Research on SAI has followed a fairly consistent timeline, such that studies within the same era have tended to investigate similar relationships. Early studies on SAI most often analyzed its relationship with psychometric intelligence, as measured by standardized intelligence tests, in order to determine whether SAI can adequately serve as a proxy for psychometric intelligence (Freund & Kasten, 2012; Hodgson & Cramer, 1977; Paulhus, Lysy, & Yik, 1998). These studies found that SAI only moderately correlates with psychometric intelligence, but these authors began to question which other variables may relate to SAI.

Later studies on SAI primarily studied its relationship with gender (Furnham, Hosoe, & Tang, 2001; Furnham, Zhang, & Chamorro-Premuzic, 2005; Syzmanowicz & Furnham, 2011). These studies correctly proposed that (a) males estimate their intelligence at higher levels than females (b) and people estimate the intelligence of male family members (i.e. father and son) at higher levels than female family members (i.e. mother and daughter). Some of these studies also investigated cultural differences in SAI, most often showing that western cultures tend to estimate their intelligence at higher levels than eastern cultures (Furnham et al., 1999, 2001). From these findings, more than intelligence itself was shown to influence SAI. Also, the study of self-assessed multiple intelligences emerged during this era (Furnham, 2000, 2001; Furnham et al., 1999), particularly the conceptualization proposed by Gardner and Hatch (1989), Gardner (1999, 2011). Gardner proposed that intelligence is composed of many more abilities than commonly believed. For instance, traditional conceptualizations of intelligence are restricted to knowledge and reasoning, whereas Gardner's conceptualization includes bodily-kinesthetic (ability to control one's bodily motions and handle objects skillfully) and interpersonal (sensitivity to others' feelings and ability to cooperate) intelligence. Studies using Gardner's conceptualization found similar findings compared to those using traditional conceptualizations – SAI still only moderately related to psychometric intelligence, and males estimate their intelligence at higher levels than females.

Today, researchers of SAI have begun studying a much wider array of relationships, moving beyond psychometric intelligence and gender (Bratko, Butkovic, Vukasovic, Chamorro-Premuzic, & Von Stumm, 2012; Kudrna, Furnham, & Swami, 2010). These other variables commonly include aspects of personality, such as the Big Five and narcissism (Gerstenberg, Imhoff, Banse, & Schmitt, 2014; Zajenkowski & Czarna, 2015). Similarly, authors have begun studying the outcomes of SAI (Chamorro-Premuzic, Gomà-i-Freixanet, Furnham, & Muro, 2009; Kornilova, Kornilov, & Chumakova, 2009). For instance, some authors have considered SAI an important predictor of academic goal striving (Chamorro-Premuzic, Ahmetoglu, & Furnham, 2008; Chamorro-Premuzic & Furnham, 2006). These authors treat SAI similar to domain-specific self-efficacy, such that students are thought to have reduced motivation towards their academic goals if they believe that they do not have the necessary intelligence to complete such goals. From these studies, some researchers recognize that SAI influences important personal outcomes; however, this is certainly not the treatment of SAI in *all* studies of the construct – or perhaps even the majority.

While the scope of research on SAI has expanded, the current scholarship could be considered disjointed. Meta-analyses have reviewed and analyzed the prior two eras of SAI research, but current research on the broader relationships of SAI has yet to be clearly integrated. Thus, the current article takes stock of prior research on SAI that has studied other relationships beyond psychometric intelligence and gender. Proposed (a) relationships of SAI and (b) moderators of these relationships are presented below, separated by these two primary sections.

We rely on social cognitive theory to conceptually detail these relationships, which integrates learning perspectives to explain human motivation (Bandura, 1986, 2001, 2011). Social cognitive theory proposes that learning occurs via an interaction of the environment, the person, and their behavior. Whenever a behavior is performed, the environment may reinforce or punish the person, which may encourage or discourage future performances of the behavior. In turn, many perceptions may develop surrounding a behavior or set of behaviors. Self-efficacy is perhaps the most commonly discussed of these perceptions, which is a general assessment of one's own capabilities; however, a person's perception of their abilities in particular domains is also a strong determinant of associated motivations and behaviors (Agarwal, Sambamurthy, & Stair, 2000; Bong & Skaalvik, 2003; McCormick, 2001). SAI could be considered such a perception. In general, people with positive perceptions surrounding a set of behaviors are more likely to perform such behaviors, whereas people with negative perceptions are less likely to perform such behaviors. For instance, a person with high SAI may be more likely to enroll in educational opportunities, because they are more likely to believe that they will succeed in such opportunities.

Further, social cognitive theory also proposes that these self-perceptions of abilities and capabilities, whether general (e.g. self-efficacy) or specific (e.g. SAI), may be developed in four different manners (Bandura, 1986, 2001, 2011). First, people may engage in mastery experiences, in which their success at performing a behavior can reinforce that they will be successful in future attempts. Second, watching similar others succeed at a behavior may cause people to vicariously believe that they may too be proficient at successfully performing the behavior. Third, people may be persuaded by others to believe that their abilities and capabilities are better or worse. Fourth, emotional states can also influence self-assessments, such that a good (bad) mood may cause people to assess their abilities and capabilities to be better (worse).

We suggest that SAI is a self-assessment that serves as an indicator of people's abilities and capabilities regarding behaviors that involve knowledge, the speed of thought, and other cognitive abilities. In other words, SAI can be considered a specific form of self-efficacy. As other authors have suggested (Grant, 1996; McIver, Lengnick-Hall, Lengnick-Hall, & Ramachandran, 2013; Wiklund & Shepherd, 2003), cognitive abilities and capabilities are essential to modern society because jobs are becoming more knowledge-based and workplace success is becoming more reliant on intelligence. Thereby, a person's social worth is becoming increasingly based on their cognitive abilities, causing SAI to be more closely tied to self-worth. Further, in agreement with social cognitive theory, SAI may relate to certain variables associated with the four manners to develop self-perceptions of abilities and capabilities. For example, SAI may be positively associated with prior education, as those with more education have had more mastery experiences associated with intelligence. Lastly, SAI may likewise be related to variables associated with heightened motivation, which would subsequently influence beneficial behaviors and positive outcomes. These proposals are applied below in detailing the relationships of SAI.

Social cognitive theory is apt at detailing the numerous relationships of SAI, but two notes should be highlighted regarding its application. First, although the preceding paragraph suggests causal relationships, causality is not investigated in the current article. Instead, only non-directional relationships of SAI are investigated. Second, the integration of social cognitive theory and SAI is not entirely novel, and prior authors have applied aspects of social cognitive theory to make predictions regarding SAI (Chamorro-Premuzic et al., 2008; Chamorro-Premuzic & Furnham, 2006; Kornilova et al., 2009). These prior investigations have generally supported the application of social cognitive theory, lending support for its application in the current article.

2.1. Relationships

In addition to psychometric intelligence and gender, we suggest that SAI is related to four categories of variables: constructs associated with intelligence, tendencies and opportunities to develop intelligence, constructs associated with biased self-assessments, and positive states and life achievements.

2.1.1. Constructs associated with intelligence

The first category consists of constructs associated with intelligence. The relationship of this category with SAI is not directly predicted by social cognitive theory, but constructs associated with intelligence are believed to relate to SAI because of their conceptual similarity. A portion of one's SAI is based on their intelligence, but it is often difficult to discern where intelligence begins and ends. For instance, it could be questioned whether creativity or emotional intelligence is an aspect of intelligence. Or, it could be questioned whether intelligence expressed in unorthodox ways (i.e. "street smarts") is representative of intelligence. For this reason, more than simply intelligence alone may represent this "core" of SAI, and these constructs include, but are not limited to, openness to experience and emotional intelligence.

Openness to experience refers to a general tendency to try new things, consider new perspectives, investigate new possibilities, and think in the abstract. The construct is also commonly considered to contain the subdimension of intellect, and both openness and this subdimension are most often measured via self-report scales (Mussel, Winter, Gelleri, & Schuler, 2011). It could be argued that this subdimension directly represents SAI when assessed via self-report, and therefore openness is predicted to strongly relate to SAI due to this conceptual overlap. On the other hand, emotionally intelligent individuals are believed to more accurately assess their own personal characteristics, including their own intelligence (Furnham, 2009a, 2015; Hughes, Furnham, & Batey, 2013; Petrides et al., 2004). This indicates that emotional intelligence may be a moderator of the relationship between psychometric intelligence and SAI; however, some authors have suggested that emotional intelligence may have a direct effect on SAI (Furnham, 2015; Hughes et al., 2013). These authors suggest that people may conflate their emotional intelligence with their intelligence, thereby causing SAI to be a mixture of emotional intelligence and intelligence. In laymen's terms, emotional intelligence is often associated with "street smarts," such as reading people and knowing how to negotiate, and people often include street smarts in assessments of their own intelligence. Therefore, emotional intelligence is predicted to positively relate to SAI.

Hypothesis 1:. SAI is positively related to (a) openness to experience (b) and emotional intelligence.

2.1.2. Tendencies and opportunities to develop intelligence

The second category relates to one's tendency and/or opportunities to develop their intelligence. Social cognitive theory suggests that experiencing a greater amount of mastery experiences, whether through personal efforts or provided opportunities, can develop both general and specific forms of efficacy, which should also hold true for SAI. Knowledge can be gained through conscious practice, and other aspects of intelligence (i.e. logic and reasoning) may also be improved through intentional effort (Au et al., 2015; Harrison et al., 2013; Shipstead et al., 2012). Even yet, research has shown that people who practice certain abilities perceive themselves to be more proficient in these abilities, whether these perceptions are accurate or not (Facteau, Dobbins, Russell, Ladd, & Kudisch, 1995; Hargittai & Shafer, 2006; Lurie et al., 2007). For these reasons, those that are more likely to develop these abilities, whether through their own tendencies for self-improvement and/or access to resources, are believed to have higher levels of SAI. Related constructs include conscientiousness, education, age, SES, and prior IQ test experience.

Conceptualizations of conscientiousness often include the dimensions of studiousness and industriousness, and conscientious people tend to work harder towards developing their knowledge, skills, and abilities (Conte & Gintoft, 2005; Gurven, Von Rueden, Massenkoff, Kaplan, & Lero Vie, 2013; Judge, Simon, Hurst, & Kelley, 2014). Likewise, conscientiousness has been included in the construct of grit (and vice versa), which is related to long-term perseverance for difficult goals (Credé, Tynan, & Harms, 2017; Duckworth, Peterson, Matthews, & Kelly, 2007; Howard & Cogswell, 2018). Because conscientious people are known to work hard towards self-improvement, including knowledge development, it is expected that conscientiousness positively relates to SAI.

Apart from personality, many demographic characteristics are associated with access to educational opportunities. Those that have completed more formal education have been exposed to larger amounts of information and more mastery experiences, which may cause them to positively reflect on their intelligence. Although educational opportunities may also expose individuals to more challenges and failure experiences, prior research has supported that simply practicing abilities improves self-perceptions of these abilities regardless of success (Facteau et al., 1995; Hargittai & Shafer, 2006; Lurie et al., 2007). This suggests that educated people may possess elevated SAI even if they did not perform well during their education. Therefore, educational experience is expected to positively relate to SAI.

Also, older individuals have had more time to enroll in educational opportunities and gather the necessary capital to enroll in these opportunities. Similarly, those with higher socio-economic

status (SES) also have the capital to enroll in educational opportunities. In both cases, these people are able to encounter more mastery experiences to heighten their SAI. Therefore, age and SES are expected to positively relate to SAI.

Likewise, those that have prior experience with IQ tests likely have had opportunities to practice for such tests, and the test itself may serve as a mastery experience to heighten test-takers' SAI. At a minimum, test takers may have gained knowledge about the measurement of intelligence through the test itself, and thereby may feel that they have better insights into intelligence. For this reason, IQ test experience is expected to positively relate to SAI.

Hypothesis 2:. SAI is positively related to (a) conscientiousness, (b) education, (c) age, (d) SES, and (e) prior IQ test experience.

2.1.3. Constructs associated with biased self-assessments

The third domain relates to one's tendency to bias self-assessments. Social cognitive theory suggests that self-assessments can be changed by the persuasion of others, but certain people may have a systematic tendency to persuade themselves to have more positive or negative self-views (Ashton & Lee, 2005, 2008; Foster & Trimm, 2008). Related constructs are believed to be unrelated to psychometric intelligence but may nevertheless relate to one's perception of their intelligence, because they relate to a systematic tendency to over- or under-estimate one's own abilities and characteristics (DeYoung, 2015). These constructs include, but are not limited to, narcissism, honesty-humility, extraversion, neuroticism, and ethnicity.

Narcissism is associated with extreme selfishness, a grandiose view of oneself, and a desire for the admiration of others (Foster, Campbell, & Twenge, 2003; Foster & Trimm, 2008). Given that narcissists have a grandiose view of themselves, these people may be more likely to have an inflated assessment of their own intelligence. On the other hand, the HEXACO model identifies honesty-humility as a unique personality trait, which includes the subdimensions of sincerity, fairness, greed avoidance, and modesty (Ashton & Lee, 2005, 2008). As honesty-humility is associated with modesty, those high in honesty-humility would be expected to report lower levels of SAI. For these reasons, SAI is expected to positively relate to narcissism, but negatively relate to honesty-humility. Further, extraverted individuals enjoy being the center of attention, and studies have shown that extraverts tend to self-enhance (Barrick & Mount, 1991; Paulhus, 1998). That is, they tend to overestimate their own positive characteristics, which is similar to certain narcissistic tendencies. For this reason, it is believed that extraversion positively relates to SAI. On the other hand, neuroticism is associated with negative emotions, self-consciousness, and self-deprecation (Barrick & Mount, 1991; Rothbart et al., 2004). Due to its association with a poor view of oneself, neuroticism is predicted to negatively relate to SAI.

Hypothesis 3:. SAI is positively related to (a) narcissism and (b) extraversion. SAI is negatively related to (c) honesty-humility and (d) neuroticism.

Further, research has identified a "white male effect," such that white males are more protective of their acquired resources (i.e. capital, job status, social status; Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000; Kahan, Braman, Gastil, Slovic, & Mertz, 2007). A proposed cause of the white male effect is the tendency of white males to over-estimate their positive personal characteristics, and thereby believe that they are more deserving than others for their acquired resources (Finucane et al., 2000; Kahan et al., 2007). Also, racial categories are still strongly divided in regards to SES in most countries. Particularly, whites typically have a higher SES compared to blacks in the United States, which may allow whites to have greater access to education resources than blacks. Given these two considerations, it is predicted that whites will rate their SAI higher than blacks.

Hypothesis 3e:. Whites rate their SAI higher than blacks.

2.1.4. Positive states and life achievements

The fourth category is positive states and life achievements. This category again relates to mastery experiences, as people may perceive their SAI as greater if they achieve certain relevant goals; however, social cognitive theory also predicts that moods and emotions influence self-assessments (Bandura, 1986, 2001, 2011). Those in a positive state and/or that have achieved many positive outcomes may perceive themselves as being more capable, which may include possessing greater intelligence, in part due to their positive moods and emotions. On the other hand, those that are indeed more intelligent (and thereby perceive themselves as more intelligent) may also feel better about themselves, experience greater motivation, and be more likely to achieve their goals. Thereby, while the current article only investigates non-directional relationships, positive states and life achievements may be both antecedents and outcomes of SAI – consistent with the triadic reciprocality predicted by social cognitive theory (Bandura, 1986, 2001, 2011). Constructs within these categories include variables related to well-being (positive self-regard, psychological well-being) and goal striving (academic achievement).

Self-regard is one's overall perception of him or herself, and may include self-esteem, self-efficacy, core-self evaluations, and other constructs. Many factors contribute to a positive self-regard, but one of the largest contributors is one's perceptions of their own collective skills and abilities. Cognitive abilities have been suggested to be the most important skill or ability for performance across most contexts, as it is a strong predictor across a wide range of tasks and occupations (Hunter & Hunter, 1984; Ree & Earles, 1992). Cognitive abilities have even been shown to be among the strongest predictors of performance even in low complexity jobs (Hunter & Hunter, 1984; Ree & Earles, 1992). Due to the centrality of cognitive abilities in perceived skills and abilities, it is proposed that SAI is positively related to positive self-regard.

Similarly, psychological well-being (i.e. stress, depression, and anxiety) is closely linked to self-perceptions and perceived abilities to overcome obstacles (Jiang, 2010; Schwarzer, 2014). Once again, cognitive abilities are a central aspect of perceived skills and abilities, and cognitive abilities are perhaps the strongest contributing factor to overcoming personal obstacles (Muris, 2002; Schwarzer, 2014). Those able to overcome obstacles generally have better psychological well-being than those that struggle with such difficulties (Jiang, 2010; Muris, 2002). Due to these linkages, we predict that SAI is positively related to psychological well-being.

Hypothesis 4:. SAI is positively related to (a) positive self-regard and (b) psychological well-being.

SAI has been studied in conjunction with academic achievement, with authors proposing that students are more (less) motivated towards academic goals if they perceive themselves as being intelligent (unintelligent; Chamorro-Premuzic et al., 2009). These authors propose that SAI may be a type of domain-specific efficacy, such that students perceive their academic goals being more obtainable when they possess relevant capabilities (i.e. SAI). In turn, they more fervently pursue these academic goals. Alternatively, students may perceive their academic goals as being unobtainable when they do not possess these relevant capabilities, and they may withdraw from their academic goals to allocate their efforts to more fruitful endeavors. Therefore, SAI is expected to positively relate to academic achievement.

Hypothesis 4c:. SAI is positively related to academic achievement.

2.2. Discriminant validity

One final direct effect is commonly studied in studies involving SAI, but authors have rarely provided a theoretical justification for why it should or should not be related to SAI (Bratko et al., 2012; Jacobs, Szer, & Roodenburg, 2012; Visser et al., 2008). This is because the construct, agreeableness, is the final dimension of the Big Five not listed above, and many authors include it in their data collection endeavors along with the other four dimensions without an a priori justification. Because many authors have studied agreeableness with SAI, it is included in the current meta-analysis; however, we do not provide a theoretical justification as to why it should or should not be related to SAI. Instead, we treat it as an indicator of SAI's discriminant validity – the relationship of two constructs that should produce a very small or null relationship.

Research Question 1: Is SAI significantly related to agreeableness?

2.3. Moderators

Almost all studies investigating SAI measure the construct in a very similar manner. Participants are presented a picture of a bell curve (i.e. normal distribution), which shows the percentages that fall within each portion of the bell curve using various standard deviation increments (e.g. 68% fall within one standard deviation). They are also shown that, for an example intelligence quotient (IQ) test, scores have a mean of 100 and a standard deviation of 15 (or sometimes 10). Participants are then asked to estimate their true IQ scores regarding certain aspects of intelligence using a multiple-point Likert scale. For instance, a participant may be shown a bell curve and then asked where they fall in regards to mathematical abilities. They could choose options on a 7-point Likert scale ranging from 70 (Extremely Below Average) to 130 (Extremely Above Average). While almost all studies apply this method, or a very similar approach, they do differ regarding their applied conceptualization of intelligence.

Studies on SAI have either applied traditional conceptualizations of intelligence or Gardner and Hatch (1989), Gardner's (1999, 2011) conceptualization of multiple intelligences. These two conceptualizations are very different. Traditional conceptualizations generally limit the construct to speed of thought, logic, knowledge, and the application of knowledge (among other selected abilities; Harrison et al., 2013; Shipstead et al., 2012; Waterhouse, 2006a, 2006b). Gardner's conceptualization is much more inclusive, and a wider array of abilities are considered representative of intelligence. Gardner's conceptualization includes abilities traditionally considered representative of intelligence (e.g. logical-mathematical, spatial, and linguistic intelligence), but it also includes abilities that are much less often incorporated (e.g. bodily-kinesthetic, interpersonal, intrapersonal, and naturalist intelligence). Due to the notable differences in these conceptualizations, studies may observe differing relationships of SAI depending on the applied conceptualization. Prior research has shown that broader constructs more strongly relate to other constructs overall (although narrow constructs more strongly relate to relevant constructs; Landers & Lounsbury, 2006; Lounsbury, Saudargas, Gibson, & Leong, 2005; Paunonen, Haddock, Forsterling, & Keinonen, 2003), and Gardner's conceptualization is indeed broader than the traditional conceptualization of intelligence. Therefore, it is believed that analyses of SAI using Gardner's conceptualization produce stronger relationships than those using traditional conceptualizations.

Hypothesis 5:. Self-assessments of multiple intelligences have stronger relationships with other variables than self-assessments of traditional intelligence.

We also test whether certain characteristics of the included sources and samples moderate the relationships of SAI. It is possible that certain source and sample characteristics nullify the effects of SAI, such that the construct's relationships are much weaker or eliminated altogether. The characteristics of interest are the samples' average gender and age as well as the sources' publication year (or the year that the sample was collected in the case of unpublished sources). While we do not present a theoretical justification for these moderated effects, it is nevertheless common to atheoretically study these effects in meta-analyses due to the availability of the associated information in published studies (Halbesleben, 2006; Ng & Feldman, 2010).

Research Question 2: Do (a) gender, (b) age, and (c) publication year moderate the relationships of SAI?

2.4. Alternative explanations

Lastly, it should be considered whether the relationships of SAI are not due to the construct itself, per se, but rather its association with psychometric intelligence. Psychometric intelligence has been shown to directly predict SAI and many other variables of interest (e.g. positive self-regard, academic achievement; Freund & Kasten, 2012; Greenberg et al., 1992; Zuffianò et al., 2013). While SAI is also believed to have substantive relationships with several of these variables, it is possible that SAI's observed relationships are largely due to both SAI and these other variables being common outcomes of psychometric intelligence, and the relationship of SAI with these other variables may greatly diminish or even disappear when accounting for the variance explained by psychometric intelligence. In other words, SAI may only relate to these other variables because they are common outcomes of psychometric intelligence.

Using a two-step meta-analytic structural equation modeling approach (detailed below; Cheung, 2015; Jak, 2015), we test whether SAI still has a relationship with the variables of interest when accounting for the relationship of psychometric intelligence. If these relationships are still significant, then the results would suggest that SAI has substantive relationships with these variables of interest; alternatively, if these results are no longer significant, then the results would suggest that SAI's relationships are only due to a common association with psychometric intelligence and thereby not substantive. Therefore, we test the following research question:

Research Question 3: When accounting for psychometric intelligence, does SAI have a statistically significant, incremental relationship with other variables?

3. Methods

Meta-analyses aggregate the results of prior studies to obtain overall estimates of effects. To test the proposed hypotheses, a meta-analysis is performed following the suggestions and guides of prior authors, the preferred reporting for systematic reviews and meta-analyses (PRISMA) standards, and the meta-analysis reporting standards (MARS) (APA, 2008; Aytug, Rothstein, Zhou, & Kern, 2012; Duval & Tweedie, 2000; Egger, Smith, Schneider, & Minder, 1997; Hunter & Schmidt, 2000; Liberati et al., 2009; Moher et al., 2009; Schmidt & Hunter, 2014). While suggestions from each source were followed, we adhered most closely to the latter of these (MARS) for the current analyses.

3.1. Identifying sources

Multiple strategies were used to identify all studies, both published and unpublished, that empirically analyzed SAI alongside variables other than psychometric intelligence and gender. First, searches were conducted in July 2017 in the following databases: PsycINFO, EBSCO, Dissertation Abstracts International, and Google Scholar. Relevant keywords were 24 different variations of "self-assessed intelligence," "self-reported intelligence," "self-evaluated intelligence," and "self-estimated intelligence." Second, the reference sections of Freund and Kasten (2012) and Syzmanowicz and Furnham (2011) were cross-referenced. Third, emails were sent to selected authors to obtain any unpublished data with the relationships of interest.

3.2. Inclusion criteria

Initially, 1944 articles, dissertations, theses, conference presentations, or unpublished data sources were identified. The authors reviewed each of these sources to determine whether (a) a sample was collected, (b) SAI was measured,[5] (c) quantitative statistics were reported, and (d) information regarding the source was written in English. This resulted in a list of 324 sources. Then, two trained researchers coded and recorded the effect sizes of the desired relationships from twenty sources at a time. Once their inter-rater agreement reached an ICC(2,2) of 0.9 or more for all effect size categories (as recommended by prior authors: de Vet, Terwee, Knol, & Bouter, 2006; Gamer, Lemon, Fellows, & Singh, 2012; Hunter & Schmidt, 2000), they proceeded to code the sources independently. In most cases, articles that measured SAI but were not included in the current meta-analysis either (a) only analyzed the relationship of SAI with psychometric intelligence and/or gender (b) or did not report statistics that could be included in a meta-analysis. In a small amount of cases, certain studies were not included because the results were reported in a separate source that was already included in the meta-analysis (Supplemental Material A). Once completed, 86 sources include an appropriate effect size for a relationship of interest to be included in the current meta-analysis. The results of these coding decisions are visually summarized in Fig. 1.

It should be highlighted that the exclusion criteria did ***not*** involve: year of data collection, publication status, participant characteristics, methodological design, assessed study quality, or any other criteria that is not explicitly stated above.

3.3. Analyses

Results were calculated using Comprehensive Meta-Analysis V3 as well as R 3.4.1. While attempts were made to reduce publication bias (i.e. contacting researchers), analyses were still performed to estimate the extent of publication bias in the current meta-analytic estimates. These analyses were fail-safe k, Egger's test, random-effects trim-and-fill method, and weight-function model analysis (Coburn & Vevea, 2015; Vevea & Hedges, 1995; Vevea & Woods, 2005). The weight-function model analysis estimates an initial random-effects meta-analytic model. Then, it estimates an adjusted random-effects meta-analytic model that includes weights for prespecified p-values intervals (typically $p < .05$ and $p > .05$). The adjusted model produces meta-analytic estimates adjusted for possible publication bias, but it also produces weights that "reflect the likelihood of observing effect sizes in each designated interval ... relative to the first interval [typically $p < .05$]"

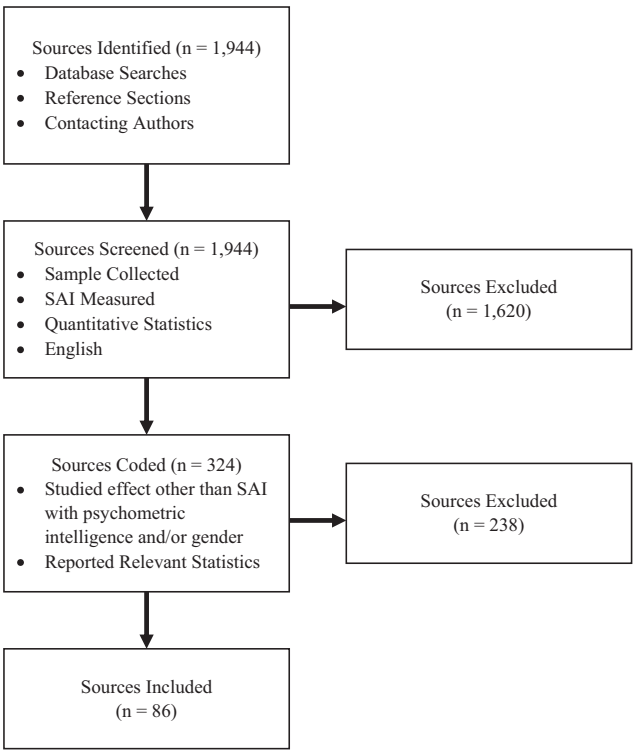

Fig. 1. Study selection flow diagram.

(Coburn & Vevea, 2015, p. 315). For example, an estimated weight of 0.25 would indicate that nonsignificant effect sizes are one-fourth as likely to be observed as significant effect sizes. A likelihood ratio test is also provided that compares the difference between the initial model and the adjusted model, and a significant result suggests that publication bias is present. For more reading on weight-function model analysis, please see Coburn and Vevea (2015), Vevea and Hedges (1995), and Vevea and Woods (2005).

Eight methods were applied to identify outliers and influential cases, and we primarily considered three of these in determining such studies: studentized deleted residuals, Cook's distance, and covariance ratios (Viechtbauer & Cheung, 2010). We calculated relevant statistics, plotted the results as line charts, and considered outliers and/or influential cases to be studies with notably higher values for multiple statistics. These results are summarized below and fully presented in Supplemental Material B.

To calculate meta-analytic effects, a random effects model was used. Most included effect sizes were reported as correlations in their original sources, but we also included other reported effects from analyses that tested the relationship of two variables alone. These other effects included t-values, chi-squares, and reported means and standard deviations of two groups. All transformations to a common effect size were performed in Comprehensive Meta-Analysis.

We did not include any effect sizes that represent the relationship of more than two variables, such as partial correlations, due to prior noted concerns regarding the inclusion of these effects in meta-analyses (Anderson et al., 2010; Boxer, Groves, & Docherty, 2015; Rothstein & Bushman, 2015). Further, in calculating effects, we adhered to the Hedges and Olkin statistical approach (1985; Kepes, McDaniel, Brannick, & Banks, 2013). Particularly, these original effect sizes were transformed to Fisher's Zs, because several prior authors have supported that meta-analytic estimates calculated using Fisher's Zs are more accurate than those calculated using correlations or other common effect sizes (Cheung, 2015;

[5] Articles were included only if they measured SAI, not self-assessed college abilities or other similar variables. This is because self-assessed college abilities and other similar variables may include several personal characteristics that are not cognitive abilities, such as personal interest in academics and/or motivation.

Jak, 2015). Likewise, in adherence to the Hedges and Olkin approach, the effect sizes were weighted by the inverse of the sampling error variance, which is directly estimated from the study's sample size (Cheung, 2015; Kepes et al., 2013). After the meta-analytic effects were calculated, the results were transformed back into correlations for interpretability purposes. Thus, all meta-analytic results presented in the current article are correlational effects, unless otherwise noted (e.g. Supplemental Material I, J, and K), but we also provide the original Fisher's Z effects in Supplemental Material C.

Also, meta-analyses typically average together multiple effect sizes for the same relationship within a single study before conducting analyses; however, recent authors have highlighted that averaging effect sizes may lead to inaccurate estimates (Cheung, 2015; Jak, 2015). For this reason, we applied a three-level meta-analytic method,[6] which handles the issue of multiple effects from a single study in a superior manner to averaging effect sizes together. This method can also identify sources of dependence within and across studies, such as the variance attributed to multiple effects recorded from the same source (Van den Noortgate et al., 2013). We report these multi-level estimates below in addition to the estimated effects of SAI.

Effects were corrected for unreliability through an artifact distribution method, which is often preferred in favor of an individual correction method (Barrick & Mount, 1991; Schmidt & Oh, 2013). Reliability estimates used to make these corrections were the average reported Cronbach's alphas for each variable across the coded articles, which are included in Table 1. It should be highlighted that correcting for reliability is more regularly associated with the Hunter and Schmidt approach to meta-analyses (Kepes et al., 2013). Thereby, the current meta-analysis is not wed to a single approach, but instead integrates the two to utilize their relative strengths.

To test moderating effects, a series of multilevel random-effect meta-regressions were conducted. Only a single moderator was included in each meta-regression due to concerns regarding statistical power when including multiple predictors in a meta-regression (Thompson & Higgins, 2002; Van Houwelingen et al., 2002). It should be noted that the majority of these moderator analyses were not statistically significant, and therefore it is not believed that including all moderators together would alter the overall interpretations of results.

To test the effects of SAI when accounting for psychometric intelligence, a series of two-step meta-analytic structural equation models were conducted. To conduct these analyses, the suggestions of Cheung (2015) were closely followed, and the syntax provided by Jak (2015) was used. For each model, both SAI and psychometric intelligence predicted the variable of interest via a directional relationship. Then, SAI and psychometric intelligence were allowed to covary. While this resulted in a fully saturated model in which model fit was perfect, the other model estimates (e.g. direct effects) still provide useful and accurate information. Particularly, the effect of SAI while accounting for psychometric intelligence could be accurately assessed.

Lastly, sensitivity analyses compare meta-analytic results of the same effect using different assumptions and/or decisions. The current meta-analysis includes ample supplemental material that includes replications of the current analyses (Supplemental Material D-K). For example, the meta-analytic estimates provided below applied a multi-level approach to address multiple effects obtained from the same source, which is preferred by many authors (Cheung, 2015; Jak, 2015; Van den Noortgate et al., 2013), but the supplemental material includes meta-analytic estimates that average multiple effects from the same source together before calculating estimates, which is regularly done in prior research (Hunter & Schmidt, 2000; Schmidt & Hunter, 2014). Likewise, the supplemental material provides meta-analytic estimates calculated using the Hedges and Olkin approach, rather than a three-level meta-analytic approach. Almost all estimates were consistent across these analyses and no inferences substantially changed, greatly supporting the robustness of the current results.

4. Results

4.1. Publication bias

Overall estimates of publication bias were calculated for each relationship tested in the current article (Table 1). For most relationships, the number of studies needed to change the statistically significant result to nonsignificant was sufficiently large (fail-safe $k > 40$). All other relationships with a fail-safe k below 10 were already not statistically significant.

Next, Egger's test indicated that publication bias is present in six relationships: SAI with emotional intelligence, SES, white-black differences, agreeableness, psychological well-being, and academic achievement. For academic achievement, the trim-and-fill results indicated that four studies may be missing from the left of the mean, suggesting that the observed effect may be overestimated. No studies were implied missing for white-black differences and psychological well-being. For the other three, however, the results indicated that studies were missing from the right of the mean, suggesting that the observed effects may be underestimated. This was also true for three other dimensions of the Big Five (conscientiousness, extraversion, and neuroticism) and positive self-regard, which is the opposite of the typical bias in meta-analyses.

To further investigate this slightly unusual result, we observed the funnel plots of these relationships as well as analyses of outliers and influential cases. Each of these funnel plots were similar to the relationship of SAI and agreeableness (Fig. 2). Due to a single outlier (Swami & Furnham, 2012a), the analyses of bias interpreted several studies missing to the right of the mean, and the estimated bias was greatly reduced when the outlier was removed. Similarly, the analyses of outliers and influential cases discovered nine studies that could be considered as such, but only two were identified as outliers and/or influential cases for more than one relationship (Hong, Peng, & O'Neil, 2014; Swami & Furnham, 2012a). All presented results, however, still include these potential outliers for four primary reasons: (1) the potential outliers may still represent meaningful and accurate data, (2) most reported effects are represented by many studies, (3) a single outlier does not have a large effect on results when a random effects model is applied, and (4) the interpretations did not differ with or without these potential outliers and/or influential cases. Thus, the current results should be interpreted as accurately estimated, not underestimated, but results calculated without identified outliers can be provided upon request.

Lastly, a weight-function model analysis was performed (Table 2). Like some other methods to detect publication bias (Coburn & Vevea, 2015; Vevea & Hedges, 1995; Vevea & Woods, 2005), the weight-function model analysis can produce estimation issues when the number of studies is low – particularly when the number of studies within the p-value intervals ($p < .05$ and $p > .05$ for the current analyses) is less than three. Of effects with a sufficient number of studies, the weight-function model only detected

[6] For analyses of publication biases and meta-analytic structural equation models, we averaged multiple effect sizes from the same study together rather than perform a multilevel meta-analysis, as certain publication bias and structural equation model analyses are not able to be readily integrated with multilevel meta-analysis. It was preferred to average the multiple effect sizes together for these analyses, due to prior precedence, rather than perform a multilevel meta-analysis for these tests.

Table 1
Cronbach's alphas and indicators of bias.

Variable	*α (S.D.)*	*# α*	*k*	*Fail safe k*	*Egger's test β_0*	*Egger's test t*	*Studies trimmed*	
							Left of mean	*Right of mean*
(1) Openness	0.66 (0.12)	14	43	3840	0.772	0.552	0	0
(2) Emotional Intelligence	0.82 (0.09)	4	8	509	12.895	2.705*	0	1
(3) Conscientiousness	0.65 (0.24)	12	40	195	2.237	1.594	0	8
(4) Education	–		7	141	−3.108	0.643	0	0
(5) Age	–		29	104	1.248	1.086	4	0
(6) SES	–		9	47	−4.714	2.717*	0	2
(7) Prior IQ Test Experience	–		3	4	7.820	1.471	0	0
(8) Extraversion	0.70 (0.13)	13	40	1211	−1.205	1.176	0	10
(9) Neuroticism	0.74 (0.13)	14	40	1688	0.576	0.466	0	11
(10) Narcissism	0.82 (0.08)	7	9	259	0.944	1.004	0	0
(11) Honesty-Humility	0.88 (0.01)	2	3	9	1.543	0.138	0	0
(12) White-Black	–		3	154	−7.207	5.267**	0	0
(13) Positive Self-Regard	0.65 (0.13)	12	15	961	−0.932	0.399	0	2
(14) Psychological Well-Being	0.84 (0.07)	11	9	70	4.630	2.555*	0	0
(15) Academic Achievement	0.84 (0.07)	21	16	3828	−12.216	6.165**	4	0
(16) Agreeableness	0.69 (0.13)	4	38	0	−5.281	3.132**	0	14
(17) Self-Assessed Intelligence	0.73 (0.13)	65						
(17a) Traditional	0.71 (0.16)	34						
(17b) Multiple	0.76 (0.11)	31						

Note. α = mean Cronbach's alpha; S.D. = standard deviation of Cronbach's alphas; # α = number of Cronbach's alphas; I^2 = percentage of variation across studies due to heterogeneity rather than chance; *k* = number of studies from which the effects were calculated; *Fail Safe k* = number of studies required to change significant results to non-significant; *Egger's test β_0* = intercept of Egger's test; *Egger's test t* = t-value of eggers test along with statistical significance (* p < .05, ** p < .01); *Studies Trimmed* = number of studies suggested to be missing from the left and right of the mean effect.

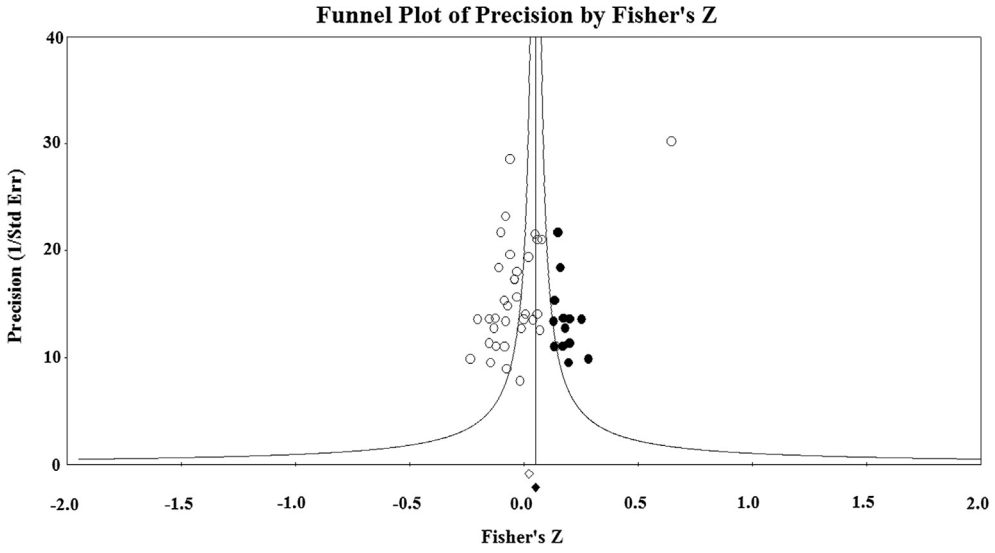

Fig. 2. Funnel plot of agreeableness effects.

significant publication bias in the effect of conscientiousness (*Weight 2 = 3.977;* p ≈ .026); however, the results again suggested that the observed effects may be underestimated, which is the opposite of the typical concern with bias in meta-analyses. Of all other effects, the analysis detected publication bias in the effect of education (*Weight 2 = 32.628;* p ≈ .020) and agreeableness (*Weight 2 = 36.420;* p < .001). Again, both of these results suggest that the observed effects may be underestimated. Also, the latter of these was not a statistically significant main effect, as detailed below, and weight-function model analyses may overestimate publication bias when effects are small (or non-significant). Thereby, of the observed effects, conscientiousness and education should be interpreted with caution according to the weight-function model analysis.

4.2. Primary analyses

Across all studies, the average sample was young (M_{age} = 23.44, SD_{age} = 6.17), female (M_{female} = 0.61, SD_{female} = 0.16), and, when reported, predominantly white (M_{white} = 0.66, SD_{white} = 0.30). The majority of studies were performed in a western context (88%). A large percentage were performed in Europe alone (48%), a sizable portion were performed in North America alone (22%), and some were performed in both Europe and North America (12%). Ten studies were performed prior to the year 2000, 34 were performed between 2000 and 2009, and 42 were performed between 2010 and the present day. The average sample size was 474 (SD = 975).

To interpret the size of results, we applied the guidelines of recent authors who suggest that Cohen's (1992) guidelines are

Table 2
Weight-function model analysis of publication bias.

Variable	*k*	β_0	τ^2	*Weight 2*	*LR* χ^2	*p*
Constructs Associated with Intelligence	49	0.150	0.045	0.416	2.849	0.091
(1) Openness	43	0.128	0.042	0.399	2.965	0.085
(2) Emotional Intelligence	8	0.189	0.056	0.010	2.684	.101[a]
Tendencies and Opportunities to Develop Knowledge	78	0.135	0.032	2.788	6.177	0.012[*]
(3) Conscientiousness	40	0.124	0.047	3.873	4.952	0.026[*]
(4) Education	7	0.325	0.066	32.628	5.371	0.020[*,a]
(5) Age	29	0.090	0.050	2.002	0.740	0.390
(6) SES	9	0.222	0.061	8.493	3.099	.078[a]
(7) Prior IQ Test Experience	3	0.001	0.114	0.069	1.553	.213[a]
Constructs Associated with Biased Self-Assessments	53	0.175	0.024	2.178	2.954	0.086
(8) Extraversion	40	0.161	0.029	2.613	3.641	0.056
(9) Neuroticism	40	−0.133	0.021	0.611	0.138	.710[a]
(10) Narcissism	9	0.298	0.021	0.010	2.400	.121[a]
(11) Honesty-Humility	3	–	–	–	–	–[b]
(12) White-Black	3	0.219	0.054	16.729	1.291	.256[a]
Positive States and Life Achievements	37	0.135	0.066	0.433	2.033	0.154
(14) Positive Self-Regard	15	0.200	0.087	0.804	0.057	0.812
(15) Psychological Well-Being	9	0.146	0.076	0.824	0.031	0.860
(16) Academic Achievement	16	0.070	0.135	0.265	2.055	0.152
(17) Agreeableness	38	0.135	0.103	38.407	14.480	<0.001[**,a]

Note. Parameter estimates are provided for the adjusted model. The likelihood ratio test is performed comparing the adjusted the unadjusted models. The degrees of freedom for all likelihood ratio tests is 1. β_0 represents the mean; τ^2 represents the standard error component. Weight 2 matches the interval .05 < p. All weights are interpreted relative to the interval p < .05.
[a] One of the compared p-value intervals (p < .05 & p > .05) contains three or fewer effect sizes, which may lead to estimation issues.
[b] No estimates could be calculated due to the small number of included studies.
[*] p < .05.
[**] p < .01.

too exigent (Bosco, Aguinis, Singh, Field, & Pierce, 2015; Gignac & Szodorai, 2016; Paterson, Harms, Steel, & Credé, 2016), placing a particular focus on Gignac and Szodorai's (2016) guidelines. These authors' cutoffs were meta-analytically calculated from contexts relevant to the current study: prior studies of individual differences. Thereby, we considered uncorrected mean correlations around 0.11 to be small, around 0.19 to be medium, and around 0.29 to be large.

Table 3 includes all meta-analytic estimates of SAI's relationships with both variable categories and individual variables, and Table 4 includes the associated variance components of each three-level meta-analytic effect. The overall relationship of SAI with constructs associated with intelligence was moderate, positive, and significant ($\bar{r}$ = 0.20, 95% CI [0.16, 0.25], *z-value* = 8.630, $\bar{\rho}$ = 0.29). SAI had a moderate, positive, and significant relationship

Table 3
Three-level meta-analytic results.

Variable	*# of Sources*	*k*	*N*	$\bar{r}$	$\bar{\rho}$	*95% C.I.*	*z-value*	*Sig*
Constructs Associated with Intelligence	43	49	13,718	0.20	0.29	0.16, 0.25	8.630	**<0.001**
(1) Openness	39	43	11,849	0.18	0.26	0.14, 0.23	7.684	**<0.001**
(2) Emotional Intelligence	7	8	2312	0.34	0.44	22, 0.45	5.359	**< 0.001**
Tendencies and Opportunities to Develop Knowledge	55	79	19,570	0.08	0.10	0.05, 0.11	4.943	**<0.001**
(3) Conscientiousness	36	40	11,381	0.06	0.08	0.01, 0.10	2.578	**0.010**
(4) Education	6	7	2189	0.18	0.21	0.07, 0.28	3.314	**<0.001**
(5) Age	14	29	5814	0.05	0.06	0.01, 0.10	2.366	**0.018**
(6) SES	4	9	1326	0.11	0.13	0.04, 0.18	2.999	**0.003**
(7) Prior IQ Test Experience	3	3	710	0.11	0.13	−0.04, 0.27	1.416	0.157
Constructs Associated with Biased Self-Assessments	44	53	18,504	0.12	0.16	0.09, 0.15	8.324	**<0.001**
(8) Extraversion	36	40	11,172	0.11	0.16	0.08, 0.15	7.332	**<0.001**
(9) Neuroticism	36	39	10,771	−0.12	−0.17	−0.16, −0.08	−6.142	**<0.001**
(10) Narcissism	5	9	1211	0.30	0.39	0.25, 0.35	11.422	**<0.001**
(11) Honesty-Humility	3	3	471	−0.17	−0.21	−0.34, 0.01	−1.856	0.063
(12) White-Black	3	3	6006	0.16	0.19	0.04, 0.28	2.696	**0.007**
Positive States and Life Achievements	33	37	21,466	0.20	0.27	0.14, 0.27	5.819	**<0.001**
(13) Positive Self-Regard	14	15	6026	0.22	0.28	0.12, 0.32	4.046	**<0.001**
(14) Psychological Well-Being	7	9	2041	0.15	0.19	0.07, 0.24	3.539	**<0.001**
(15) Academic Achievement	15	16	15,864	0.20	0.28	0.08, 0.31	3.282	**0.001**
(16) Agreeableness	34	38	10,482	−0.02	−0.03	−0.07, 0.02	−1.060	0.289

Note. *# of Sources* = number of sources from which the effects were calculated; *k* = number of studies from which the effects were calculated; *N* = total sample size of calculated effects; $\bar{r}$ = mean inverse-variance-weighted correlation; $\bar{\rho}$ = mean inverse-variance-weighted correlation corrected for unreliability; *95% C.I.* = 95 percent confidence interval of the inverse-variance-weighted correlation; *z-value* = z-value of the inverse-variance-weighted correlation; *Sig* = p-value of the inverse-variance-weighted correlation.
Bold indicates a statistically significant relationship at a .05 level of significance.

Table 4
Variance components of three-level meta-analytic effects.

Variable	$\tau^2_{(2)}$(*Std. Err*)	$\tau^2_{(3)}$	*Q*	*df*	$I^2_{(2)}$	$I^2_{(3)}$
Constructs Associated with Intelligence	0.007 (0.002)	0.019 (0.005)	1408.443***	123	0.224	0.641
(1) Openness	0.006 (0.002)	0.017 (0.005)	1336.315***	115	0.231	0.616
(2) Emotional Intelligence	0.016 (3 9 0)	0.016 (3 9 0)	141.880***	7	0.463	0.463
Tendencies and Opportunities to Develop Knowledge	0.007 (0.001)	0.013 (0.003)	1986.334***	285	0.282	0.528
(3) Conscientiousness	0.001 (0.001)	0.016 (0.004)	1122.457***	111	0.063	0.744
(4) Education	0.004 (0.004)	0.015 (0.013)	83.673***	19	0.172	0.645
(5) Age	0.004 (0.002)	0.008 (0.004)	217.341***	66	0.237	0.493
(6) SES	0.031 (0.007)	0.006 (0.006)	384.155***	70	0.677	0.133
(7) Prior IQ Test Experience	0.000 (0.003)	0.015 (0.014)	26.388**	11	0.000	0.833
Constructs Associated with Biased Self-Assessments	0.011 (0.002)	0.004 (0.002)	1220.868***	235	0.581	0.207
(8) Extraversion	0.008 (0.002)	0.003 (0.002)	383.970***	103	0.539	0.166
(9) Neuroticism	0.004 (0.002)	0.009 (0.003)	518.538***	103	0.243	0.507
(10) Narcissism	–	–	2.789	9	0	0
(11) Honesty-Humility	0.000 (0.008)	0.020 (0.020)	24.697**	10	0	0.784
(12) White-Black	–	0.010 (0.001)	68.708***	4	0	0.929
Positive States and Life Achievements	0.004 (0.001)	0.039 (0.010)	4176.941***	112	0.092	0.864
(14) Positive Self-Regard	0.006 (0.003)	0.035 (0.015)	591.327***	38	0.143	0.790
(15) Psychological Well-Being	0.004 (0.004)	0.012 (0.009)	106.653***	24	0.202	0.537
(16) Academic Achievement	0.002 (0.001)	0.056 (0.021)	3118.634***	52	0.029	0.950
(13) Agreeableness	0.007 (0.002)	0.011 (0.005)	647.013***	101	0.305	0.487

Notes. $\tau^2_{(2)}$ is the associated second-level estimate; $\tau^2_{(3)}$ is the associated third-level estimate; *Q* is an estimate of the homogeneity of effect sizes; *df* is the number of associated model degrees of freedom; $I^2_{(2)}$ is the variance attributed to the second-level; $I^2_{(3)}$ is the variance attributed to the third-level.
* p < .05.
** p < .01.
*** p < .001.

with openness to experience ($\bar{r}$ = 0.18, 95% CI [0.14, 0.23], *z-value* = 7.684, $\bar{\rho}$ = 0.26), supporting Hypothesis 1a. SAI also had a large, positive, and significant relationship with emotional intelligence, supporting Hypothesis 1b ($\bar{r}$ = 0.34, 95% CI [0.22, 0.45], *z-value* = 5.359, $\bar{\rho}$ = 0.44).

The overall relationship of SAI with tendencies and opportunities to develop knowledge was small, positive, and significant ($\bar{r}$ = 0.08, 95% CI [0.05, 0.11], *z-value* = 4.943, $\bar{\rho}$ = 0.10). SAI had a small, positive, and significant relationship with conscientiousness ($\bar{r}$ = 0.06, 95% CI [0.01, 0.10], *z-value* = 2.578, $\bar{\rho}$ = 0.08), age ($\bar{r}$ = 0.05, 95% CI [0.01, 0.10], *z-value* = 2.366, $\bar{\rho}$ = 0.06), and SES ($\bar{r}$ = 0.11, 95% CI [0.04, 0.18], *z-value* = 2.999, $\bar{\rho}$ = 0.13). These results support Hypothesis 2a, 2c, and 2d. While most of these effects were significant, they were notably small. SAI had a moderate, positive, and significant relationship with education ($\bar{r}$ = 0.18, 95% CI [0.07, 0.28], *z-value* = 3.314, $\bar{\rho}$ = 0.21) and a small but nonsignificant relationship with prior IQ test experience ($\bar{r}$ = 0.11, 95% CI [−0.04, 0.27], *z-value* = 1.416, $\bar{\rho}$ = 0.13). These results support Hypothesis 2b but do not support Hypothesis 2e.

The overall relationship of SAI with constructs associated with biased self-assessments was small, positive, and significant when the effects of neuroticism and honesty-humility were reverse-coded ($\bar{r}$ = 0.12, 95% CI [0.09, 0.15], *z-value* = 8.324, $\bar{\rho}$ = 0.16). SAI had a large, positive, and significant relationship with narcissism ($\bar{r}$ = 0.30, 95% CI [0.25, 0.35], *z-value* = 11.422, $\bar{\rho}$ = 0.39), and a small, positive, and significant relationship with extraversion ($\bar{r}$ = 0.11, 95% CI [0.08, 0.15], *z-value* = 7.332, $\bar{\rho}$ = 0.16). These results support Hypothesis 3a and 3b. SAI had a small, negative, and significant relationship with neuroticism ($\bar{r}$ = −0.12, 95% CI [−0.16, −0.08], *z-value* = −6.142, $\bar{\rho}$ = −0.17), but a moderate, negative, and nonsignificant relationship with honesty-humility ($\bar{r}$ = −0.17, 95% CI [−0.34, 0.01], *z-value* = −1.856, $\bar{\rho}$ = −0.21). These results support Hypothesis 3c, but they do not support Hypothesis 3d. Whites estimated their SAI at higher levels than blacks ($\bar{r}$ = 0.16, 95% CI [0.04, 0.28], *z-value* = 2.696, $\bar{\rho}$ = 0.19), supporting Hypothesis 3e.

The overall relationship of SAI with positive states and life achievements was moderate, positive, and significant ($\bar{r}$ = 0.20, 95% CI [0.14, 0.27], *z-value* = 5.819, $\bar{\rho}$ = 0.27). SAI had a moderate, positive, and significant relationship with positive self-regard ($\bar{r}$ = 0.22, 95% CI [0.12, 0.32], *z-value* = 4.046, $\bar{\rho}$ = 0.28), and it had small-to-moderate, positive, and significant relationships with psychological well-being ($\bar{r}$ = 0.15, 95% CI [0.07, 0.24], *z-value* = 3.539, $\bar{\rho}$ = 0.19). These results support Hypotheses 4a and 4b. SAI had a moderate, positive, and significant relationship with academic achievement ($\bar{r}$ = 0.20, 95% CI [0.08, 0.31], *z-value* = 3.282, $\bar{\rho}$ = 0.28). This result supports Hypothesis 4c.

SAI's relationship with the final dimension of the Big Five, agreeableness, was very small, negative, and nonsignificant ($\bar{r}$ = −0.02, 95% CI [−0.07, 0.02], *z-value* = −1.030, $\bar{\rho}$ = −0.03). SAI does not have a significant relationship with agreeableness, addressing Research Question 1.

Each relationship of SAI was separated by the studies' measurement method, and these results are included in Supplemental Material D–H. Few notable differences were seen in effect sizes when separated by the measurement method, and no substantial differences were seen when the number of studies was sufficiently large. Also, separate random-effects meta-regressions were performed in which the measurement method was the only predictor (Supplemental Material I). The measurement method was not a significant predictor in any of these analyses (p > .05), suggesting that the measurement method does not have a notable influence on the magnitude of the studied relationships. This result fails to support Hypothesis 5.

Similarly, Supplemental Material J and K provide separate random-effects meta-regressions in which the samples' average gender or age was the only predictor, respectively. Gender was a significant predictor for only a single relationship, SAI and academic achievement (B_1 = 0.011, *S.E.* = 0.003, 95% CI [0.006, 0.016], *z-value* = 4.147). This suggests that gender is not a consistent

moderator of SAI's relationships, but a notable moderating effect may exist for the specific relationship of SAI with academic achievement. Age was a significant predictor in only three of the 12 tested relationships, suggesting that it is not a consistent moderator of SAI's relationships. It should be highlighted that the effect of age on the relationship between neuroticism and SAI was particularly strong (B_1 = 0.015; *S.E.* = 0.004; 95% CI [0.007, 0.023], *z-value* = 3.579), suggesting that it may be a moderator for this specific relationship. Lastly, the test of publication year's effect on SAI's relationships resulted in extreme estimation issues for each meta-analytic regression, suggesting that publication year did not have an effect on these relationships. Gender, age, and publication year appear to not have a moderating effect on the relationships of SAI, addressing Research Question 2a, 2b, and 2c. It should be highlighted that the Q and τ^2 values were generally large, often above the 25th percentile of previously reported Q and τ^2 values (van Erp et al., 2017). Therefore, while these moderating effects were not significant, the variance of observed effects suggests that moderating effects likely exist.

Supplemental Material L presents the results of two-step meta-analytic structural equation models. To be included, at least three prior sources must have reported the effects of SAI with psychometric intelligence, SAI with the variable of interest, and psychometric intelligence with the variable of interest. Model fit indices are not reported because each model was fully saturated, and thereby each model has perfect fit. Nevertheless, the results can still provide accurate direct effects.

Nine effects of SAI were tested while including the effects of psychometric intelligence; eight of which were statistically significant when analyzing SAI alone, above. Of these eight effects, seven were still statistically significant when accounting for psychometric intelligence. These were the effects of SAI with openness (β = 0.163, 95% CI [0.113, 0.212]), conscientiousness (β = 0.059, 95% CI [0.009, 0.109]), extraversion (β = 0.113, 95% CI [0.072, 0.153]), neuroticism (β = −0.123, 95% CI [−0.168, −0.077]), narcissism (β = 0.320, 95% CI [0.264, 0.378]), positive self-regard (β = 0.209, 95% CI [0.091, 0.323]), and academic achievement (β = 0.187, 95% CI [0.071, 0.294]) (all uncorrected β). The effect of SAI was stronger than the effect of psychometric intelligence for six of these models. These were the effects of psychometric intelligence with openness (β = 0.080, 95% CI [0.024, 0.143]), conscientiousness (β = −0.011, 95% CI [−0.087, 0.065]), extraversion (β = −0.012, 95% CI [−0.087, 0.063]), neuroticism (β = −0.015, 95% CI [−0.097, 0.068]), narcissism (β = −0.052, 95% CI [−0.154, 0.048]), and positive self-regard (β = 0.013, 95% CI [−0.098, 0.119]) (all uncorrected β). Therefore, the relationships of SAI appear robust even when accounting for psychometric intelligence, addressing Research Question 3. It should also be highlighted that the observed relationship of SAI with psychometric intelligence (β = 0.238 - 0.340; uncorrected) were similar to the findings of Freund and Kasten (2012), supporting the accuracy of this analysis.

5. Discussion

As supported by social cognitive theory, SAI was proposed to relate to four categories of variables: constructs associated with intelligence, tendencies and opportunities to develop intelligence, constructs associated with biased self-assessments, and positive states and life achievements. SAI was moderately related to constructs associated with intelligence, and it had significant relationships with both openness to experience (Hypothesis 1a) and emotional intelligence (Hypothesis 1b). It had the weakest relationships with tendencies and opportunities to develop intelligence. SAI had significant, but small, relationships with conscientiousness (Hypothesis 2a), age (Hypothesis 2c), and SES (Hypothesis 2d). It had a moderate relationship with education (Hypothesis 2b) but a non-significant relationship with prior IQ test experience (Hypothesis 2e). Next, SAI had similar, but slightly stronger, relationships with constructs associated with biased self-assessments, and it had significant relationships with narcissism (Hypothesis 3a), extraversion (Hypothesis 3b), neuroticism (Hypothesis 3c), and white-black differences (Hypothesis 3e). Its relationship with honesty-humility was only marginally significant (Hypothesis 3d). SAI moderately related to positive states and life achievements. SAI had significant relationships with positive self-regard (Hypothesis 4a), psychological well-being (Hypothesis 4b), and academic achievement (Hypothesis 4c). SAI did not have a significant relationship with agreeableness (Research Question 1).

The type of measurement method was predicted to moderate the relationships of SAI, but this hypothesis was not supported (Hypothesis 5). None of the other moderation hypotheses were supported, which included gender (Research Question 2a), age (Research Question 2b), and publication year (Research Question 2c). Likewise, the significant relationships of SAI were still significant when accounting for psychometric intelligence (Research Question 3), suggesting that the relationships of SAI are robust. Together, these results have several implications for research and practice.

5.1. Implications

The current results suggest that SAI may be a perceptual bias, as several of SAI's strongest relationships were with constructs associated with biased self-assessments. Within this category of variable, it should be emphasized that SAI had sizable relationships with constructs closely associated with biased self-assessments, narcissism and honesty-humility (Ashton & Lee, 2008; Foster et al., 2003), but it also had significant relationships with constructs less-closely related to biased self-assessments, extraversion and neuroticism (Paulhus, 1998; Rothbart et al., 2004). This finding suggests that SAI is sensitive to subtler tendencies to bias self-assessments, and this finding also helps explain SAI's lackluster relationship with psychometric intelligence. The relationship of SAI with narcissism alone was comparable to its previously discovered meta-analytic relationship with psychometric intelligence (Freund & Kasten, 2012). When considered in conjunction with other tendencies to bias self-assessments, the cumulative effects on SAI are likely even stronger than that of psychometric intelligence.

Despite the effect of perceptual biases, SAI appears to be still based on perceptions of the self; however, people may not only consider their "book smarts" when assessing their SAI. Instead, they may consider several other aspects of the self, most notably their emotional intelligence. Like narcissism, emotional intelligence had a relationship with SAI that was comparable to its previously discovered meta-analytic relationship with psychometric intelligence (Freund & Kasten, 2012). This finding may again help explain the lackluster relationships between SAI and psychometric intelligence; people appear to base their perceptions of intelligence on their emotional intelligence at comparable levels to their psychometric intelligence, which forces psychometric intelligence to have a much smaller effect on SAI. This suggests that people may consider their interpersonal abilities to be a valuable component of their intelligence (Furnham, 2009a, 2015; Hughes et al., 2013; Petrides et al., 2004).

Because SAI may be influenced by many constructs outside of psychometric intelligence, it is understandable that SAI had small relationships with tendencies and opportunities to develop intelligence. The largest relationship of these variables, SAI and education, was still smaller than the relationships of SAI with narcissism as well as emotional intelligence. This finding further

emphasizes the need to analyze variables outside of psychometric intelligence to understand the emergence of SAI, and the three categories of predictors provided in the current article can serve as a starting point for these theoretical considerations. It also highlights that mastery experiences, which are suggested by social cognitive theory to influence self-assessments, may not have as large of an effect on SAI as other domain-specific assessments of capabilities. This finding may be because educational opportunities also produce challenges and failure experiences. While it has been supported that practicing abilities improves self-perceptions of these abilities, regardless of success, this effect may be particularly weak for SAI. For this reason, more research is needed regarding the practice of abilities and SAI.

Further, SAI was shown to relate to positive states and life achievements. As mentioned, positive states and life achievements may be both an antecedent and outcome of SAI as suggested by social cognitive theory. Conceptualized as an antecedent of SAI, these variables may alter self-assessments via mood effects and/or mastery experiences. Conceptualized as an outcome of SAI, these variables may be due to SAI's effect on motivation, and thereby SAI may have a large impact on well-being and ultimate life success. Perhaps more importantly, this result may also address an important question: *why* are SAI assessments biased? Because SAI is notably related to beneficial constructs, including broader self-assessments, it may be personally beneficial for people to subconsciously over-estimate their intelligence. This bias may serve as a protective factor, such that people may still possess positive self-assessments (and perhaps high psychological well-being) in the face of contradictory evidence. Prior research has supported similar effects across many contexts, such that people bias their perceptions of personal achievements in order to maintain their happiness (Gilbert, Gill, & Wilson, 2002; Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; Wilson & Gilbert, 2005; Wilson et al., 2000), and we suggest that similar effects may commonly occur regarding SAI. Therefore, if SAI is indeed a predictor of these outcomes, then the construct may be more essential to well-being than commonly believed.

We also proposed that SAI is related to white-black differences due to systematic biases in self-perceptions. While prior research has suggested that whites over-estimate their personal characteristics (i.e. white male effect; Finucane et al., 2000; Kahan et al., 2007), it is possible that blacks under-estimate their personal characteristics. Similarly, prior research has supported a "male hubris, female humility" regarding SAI, such that females estimate their intelligence at lower levels than males. The observed relationship between SAI and well-being may suggest that a "male commendation, female derogation" effect may instead exist, thereby suggesting that gender differences in SAI may be more detrimental than often considered. Similar sentiments could be expressed for white-black differences in SAI, and important approaches may need to be taken for educational and therapeutic interventions targeting particular populations to possibly provide benefits to positive personal outcomes (Muris, 2002; Schwarzer, 2014).

These observed results were also consistent when accounting for psychometric intelligence, which suggest that SAI does not simply relate to these other variables due to their common association with psychometric intelligence. Instead, SAI is an important self-assessment that demonstrates substantive relationships. This is further reinforced by the finding that SAI had a non-significant relationship with agreeableness, which supported the discriminant validity of SAI. This suggests that SAI does not simply have a notable relationship with all other variables, and the observed effects are substantive and theoretically-driven relationships.

Relatedly, social cognitive theory was used to detail the relationships of SAI, and the numerous significant observations support that this theory may indeed be an appropriate lens to understand SAI. Like other self-assessments of abilities and capabilities, SAI appears to be influenced by certain mechanisms identified by social cognitive theory, such as mastery experiences, moods, and emotions. Both researchers and practitioners can subsequently apply this theory to better understand the nature of SAI, and perhaps harness it for positive personal outcomes. Before doing so, however, future research should perform more nuanced studies on SAI, several of which are suggested below.

5.2. Future research

The current article highlighted several relationships that have yet to be thoroughly tested. First, the relationship between race and SAI should be investigated further. Particularly, only three studies could be identified that studied white-black differences in SAI, and these studies did not investigate theoretically-supported moderating or mediating effects. Relatedly, some authors have investigated the differences in SAI between other racial comparisons (i.e. white-Asian American, white-Hispanic), but again few theoretically-supported moderating or mediating effects were tested in these studies. Once these effects are established to exist, it is perhaps even more important to identify *why* and *when* these effects exist. Through doing so, subsequent research could identify methods to eliminate these SAI disparities, which could be an important effort due to the detriments of having low SAI.

Second, the current meta-analysis provided a general overview of SAI's many relationships, but future research should perform more nuanced investigations into specific relationships. Although age did not have a significant moderating effect on most relationships of SAI,[7] it may nevertheless play an important role in the dynamics of SAI. Particularly, young children may have a weaker relationship between SAI and psychometric intelligence until they undergo their first mastery experiences. At this point, the relationship between SAI and psychometric intelligence may grow stronger, and the relationship of SAI with broader outcomes may also strengthen because children may begin to recognize the importance of intelligence for goals that modern society values. These relationships may hold true until cognitive declines begin to occur, and the relationships of SAI may begin to change. Each of these phases, from early childhood to older adulthood, could provide informative contexts to study SAI, and, if causal relationships can be tested, also inform the development of broader aspects of the self (e.g. well-being, personality) through the effect of SAI.

Third, more research is needed to understand the relationship between SAI and personal outcomes. While the current meta-analysis initially supported that SAI has a relationship with possible personal outcomes, the results were somewhat limited in scope and could not support causality. Future research should investigate the effect of SAI on a wider range of outcomes in conjunction with other predictors. The effect of SAI may be explained by certain more-proximal predictors (i.e. mediators), thereby providing a deeper understanding of why SAI influences outcomes. Likewise, these future studies could apply longitudinal methods to support causality between SAI and outcomes, which could not be achieved in the current article. Subsequent research could then test methods to overcome the detrimental personal consequences of low SAI.

Fourth, future research should consider why the type of intelligence assessed did not moderate most relationships. It is reasonable to believe that broader conceptualizations of intelligence should relate to more constructs, but this was not found in the current article. It is possible, if not probable, that people already

[7] It should be noted that curvilinear moderating effects of age were tested for each of the relationships investigated in the current article. The curvilinear moderating effect was not significant in any of these analyses.

incorporate these broader conceptualizations of intelligence when assessing their own intelligence using traditional conceptualizations. For example, a researcher could apply a traditional conceptualization and ask participants to assess their intelligence through considering their knowledge and speed of thought. In assessing their speed of thought, the participant could recall their performance during sporting activities and judge that their speed of thought is above-average because they were able to react quickly in these sporting activities. This assessment would align with Gardner and Hatch (1989), Gardner's (1999, 2011) multiple intelligence dimension of bodily-kinesthetic, thereby causing the traditional and non-traditional conceptualizations of intelligence to overlap. While this is only one example, several other instances can be provided in which assessments of traditional intelligence can overlap with assessments of non-traditional conceptualizations.

Fifth, because SAI was shown to be an important reflection of the self, future research should more strongly consider the biases involved with measuring SAI via self-report. From our review of the literature, it appears that few researchers have investigated the construct's relationship with typical biasing factors, such as social desirability and impression management. If shown to be a concern, another important avenue of future research could be investigations into alternative methods to gauge SAI, such as implicit association tests.

Sixth, research should more directly investigate the relationships of SAI as predicted by social cognitive theory. While social cognitive theory explained the relationships investigated in the current article, many core tenets of the theory were not able to be investigated. Future researchers could study whether persuasion from others and/or social modeling can indeed influence SAI, for example. Likewise, many aspects of social cognitive theory were not detailed. The theory emphasizes the close relationship of a person and their environment in the decision to perform behaviors, which are often explored via experimental designs (Bandura & Locke, 2003; Bouffard-Bouchard, 1990; Compeau & Higgins, 1995; Compeau et al., 1999). The theory also includes the importance of expectancies in deciding whether to perform a behavior. Neither of these aspects were tested, which is a clear avenue for future research.

Seventh, researchers should consider the simultaneous effect of multiple antecedents together when predicting SAI. Both, the effect of multiple variables from a single category as well as a few variables from multiple categories, can provide important information regarding SAI. In the former, the unique effect of each predictor can better be understood, such that the most influential predictor from a single category can be identified. In the latter, the overall ability to predict SAI can be better understood. Through this effort, the best methods to elicit high SAI could be identified, which could aid in the creation of beneficial interventions (Goleman, 2006; Muris, 2002; Schwarzer, 2014).

Lastly, the current meta-analysis provided initial support that SAI relates to other important variables when accounting for psychometric intelligence. Future research should continue to study SAI and psychometric intelligence together, and a greater focus should be placed on identifying the effect of SAI beyond psychometric intelligence. Doing so would continue to highlight the importance of SAI and further support that findings regarding psychometric intelligence may not entirely generalize to SAI (and vice versa).

5.3. Limitations

As with all studies, certain limitations should be noted. The current article did not provide a thorough discussion of certain theoretical intricacies regarding the included effects. Most notably, we discussed and tested the overall relationship of emotional intelligence and SAI; however, several conceptualizations and even more operationalizations exist for emotional intelligence (Goleman, 2006; Mayer & Salovey, 1993), and any observed results would differ based on the applied operationalization. Similarly, we tested the moderating effect of certain intelligence operationalizations. Some authors have expressed doubt regarding the validity of the multiple intelligence conceptualization (Waterhouse, 2006a, 2006b), which should be considered when interpreting these results.

Several additional moderator effects could be tested for each relationship of SAI. For many of these effects, however, too few studies analyzed the relationship of interest for moderator analyses to be considered reliable. For instance, only seven different sources analyzed the relationship between emotional intelligence and SAI, which is smaller than prior recommendations for determining moderated relationships in a meta-analysis (Hunter & Schmidt, 2000; Schmidt & Hunter, 2014). Future research should be performed on these relationships, such that a future study could then test these and similar other moderating effects.

The current article integrated the Hedges and Olkin approach along with the Hunter and Schmidt approach to calculate meta-analytic effects. We also adhered to both MARS and PRISMA when reporting our results, and we provide ample additional material to serve as sensitivity analyses. It is possible, however, that we neglected to report some typical aspects of either approach and/or guidelines. For this reason, we provide MARS and PRISMA checklists in Supplemental Material M and N to direct readers to associated material.

Lastly, while the current meta-analysis included several cross-cultural studies, it should be noted that the majority of studies were conducted in a Western context. For this reason, the results should not be assumed to generalize across all samples and cultures.

6. Conclusion

The goal of the current article was to take stock of the "other" relationships of SAI. The results supported that SAI relates to many variables within many domains, indicating that it may be more central to the self than commonly believed. These results were largely consistent when accounting for psychometric intelligence, suggesting that SAI demonstrates substantive, theoretically-driven relationships. Future research should further explore these relationships and continue to integrate SAI with relevant psychological theory.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrp.2018.09.006.

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Articles included in meta-analysis are marked with asterisks.

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