Trends in Research on Self-Reference, Depression, and the Self-Referent Encoding Task: A Critical Review

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Understanding how people refer to themselves allows for a deeper understanding of mood and the actions individuals take. The self-referent encoding task (SRET) has been used in clinical psychological science to measure differences in self-referent thought and memory bias relating to depression, self-esteem, and self-memory. This review critically explores the history and function of the SRET, especially as connected to depressive symptoms, and covers possible future topics of research. Four major areas of SRET research are identified: (1) memory and memory bias, (2) neuroimaging and electroencephalographic recording, (3) longitudinal or developmental paradigms, and (4) personality and self-esteem. I address criticisms of the SRET, including replicability and psychometric validity. Future directions for research using the SRET may aim to identify ideal paradigms, use the SRET as a marker of change in depression, and fully disentangle its possible outcomes.

Keywords: self-reference, depression, self-schema, SRET

Major depressive disorder (MDD) affects millions of Americans each year, with even more experiencing depressive symptoms that do not reach syndrome levels (Kessler et al., 2005). Depressive disorders are debilitating and have serious personal impacts (Berto et al., 2000). Researchers in the affective sciences continue to explore the causes of depressive symptoms as well as the variables that may affect their course. In particular, one area of investigation has been the question of how the experience of depressive symptomatology may impact cognition: what is unique about depressive thought? How do individuals who are depressed think? This review explores some important aspects of these questions as they relate to the self.

The cognitive model proposes that an individual's attitudes about the world—and one's ways of attending, interpreting, and remembering experiences—are integral to the development and maintenance of depression. One vital component of the cognitive model is what theorists refer to as the self-schema (Beck & Haigh, 2014; Davis & Unruh, 1981; Segal, 1988). The self-schema includes one's stable beliefs and generalizations about oneself—the self-concept. The self-concept has been important in understanding the psychology of personality for some time (Markus, 1977; Sherif et al., 1965). For example, Sherif et al. (1965) discuss how the involvement of the self (ego) stabilizes decision-making and attitudes, forming a stable method of interpreting the world. The self-schema is understood to develop early and to be relatively stable (Dozois & Beck, 2008).

The negative self-schema is a deep-rooted cognitive component of depressive thought—conjectured as the mood-congruent negative view of the self from which other negative beliefs arise (Beck, 1979; Weissman & Beck, 1978). A negative self-schema and its inverse, the lack of activated positive self-schema, are hypothesized as both mechanistic in the development of depressive thought (Beck, 1991; Beck & Bredemeier, 2016; Watson, Clark, & Tellegen, 1988) and as symptoms of depression which are involved in its maintenance (Beevers, 2005). Beck's (1967) cognitive model of depression posits that individuals' dysfunctional views about themselves, their future, and their environments work together to lay the groundwork for MDD. This tripartite construct is often called the depressive cognitive triad and has been extensively studied (Beckham et al., 1986).

Depressed individuals have more negative ideas about the world (Alloy et al., 1999; Blackburn et al., 1986; Dobson & Shaw, 1987) and are more likely to report that negative adjectives describe them (Derry & Kuiper, 1981; Dobson & Shaw, 1987). Depressed individuals also demonstrate a negative self-concept or cognitive style (Alloy et al., 1999; Asarnow et al., 1987; Beck et al., 1990; McCauley et al., 1988; Tarlow & Haaga, 1996). Some of the unique cognitive features present in depression, for example lack of positive affect (Clark & Watson, 1991), are highlighted by the nega-

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This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The author declares no conflicts of interest.

tive self-concept and lack of positive self-concept. There is also increasing evidence for diminished positive emotion in depression (Cataldo et al., 2023; Teasdale & Russell, 1983; Vanderlind et al., 2022; Winer & Salem, 2016). Alternatively, some have framed this instead as devaluation (rather than lack) of positive affect (Bogaert et al., 2023; Pool et al., 2016; Winer & Salem, 2016). These patterns thus demonstrate that the depressive self-schema is both negative and lacking in a positive self-view.

Proponents of the cognitive theory of depression view self-schema broadly as one's self-definition. Stemming from this definition, *self-reference* is an actionable aspect of self-schema that can be conscious. Individuals quickly and readily interact with information that is self-referent, and recall it more easily (Kuiper & Derry, 1982). Models of self-schema suggest that when an individual is depressed, self-schematic information relating to depression is more readily available; the self-schema is how the individual views themselves, which influences how they process incoming information about the world. For example, sad memories are more readily recalled when a negative self-schema is activated (Brown & Taylor, 1986; Watkins et al., 1992). Thus, the self-schema guides the recall of past experiences, influencing perception of the present and one's actions (Kuiper et al., 1985; Segal, 1988). For example, a history of social or romantic rejection may result in ambiguous cues from a romantic partner being interpreted as rejection. Additionally, such cognitive biases may amplify the impact of negative life events, resulting in depressive symptoms (Beck, 1967; Gotlib & Joormann, 2010). However, one challenge has long been to measure self-schema; how can a factor underlying the presentation of the self be measured? Here self-reference has become a useful stand-in for self-schema: a measurable construct that specifically identifies the conscious component of self-schema.

Given increased interest in self-reference and measurements of it in the last several years, as well as methodological developments for the task, I argue that a critical review of the field, especially as it relates to depression, is timely. The development of new hypotheses will provide the field with additional directions to investigate. Additionally, critiques of self-reference in depression may prove important for critical use of it in psychological research.

The self-reference effect has been reviewed as it pertains to memory (Klein, 2012; Symons & Johnson, 1997) and negative biases (Wisco, 2009), although not in the past decade. In general, the self-reference memory effect suggests the fact that memory is increased for knowledge relating to the self (Symons & Johnson, 1997). This review and meta-analysis argued that increased memory for self-relevant information would result due to the well-developed structure of the self-schema, thus increasing elaboration of such material (Symons & Johnson, 1997). This effect may be complicated by a memory bias, which within the context of depression may result in depressed participants who recall more negative and less positive information (Wisco, 2009). This relationship between depression and self-reference may also result in changes in neurocognitive processes (Butterfield et al., 2023; Frewen et al., 2020; Lou et al., 2019).

Self-reference within depression itself has been analyzed in relation to abnormal self-knowledge (Lou et al., 2019) (i.e., misbeliefs about the self), as well as in comparison to other-referencing in a recent meta-analysis (Collins & Winer, 2023). Self-reference is a widely-studied phenomenon, in various fields of psychology, that invites both critique and exploration. Through understanding other facets, this research literature has greater opportunity to be useful as a marker of change, or as a component of depressive thought. I will focus on these two aspects in particular, largely beyond the scope of earlier reviews. The aforementioned meta-analysis argued for a reward devaluation view of self-referential encoding (Collins & Winer, 2023), suggesting that self-referential processing focuses both on devaluation of positive as well as a negativity bias (Winer & Salem, 2016). This devaluation of the positive, in theory, is more explicit than simply decreased positive affect, or may represent an avoidance of positive stimuli (Pool et al., 2016), in line with cognitive theory (Beck & Bredemeier, 2016).

The objective of the current review is to discuss a specific method for measuring self-reference, the self-referent encoding task (SRET). I will discuss measurement and psychometrics before addressing four major areas wherein self-reference and self-schema have been of interest. These include, (1) as a method of understanding memory biases; (2) as a marker of a neuropsychological functioning; (3) within the context of stability, longitudinal research, and as a marker of change in intervention research; and (4) with a focus on personality and self-esteem. I will also address critiques and future directions of self-reference and behavioral tasks used to measure it. I provide a critical review (Grant & Booth, 2009) of these topics that generates new hypotheses and provides future scholars with a summary of the field.

Methods

Articles relating to self-reference, self-schema, and the self-referent encoding task were collected. I include relevant studies from a search of the PsycINFO database for terms "self-referen*" AND "depress*". In November 2023, 2,421 articles combined both terms when accessed through the author's institutional library. Additional articles linked by the results of that search, or articles citing those articles, were included. Articles that primarily focused on the SRET in the context of depression are discussed; articles that focused primarily on alternative understandings of self-reference beyond those discussed in this introduction, or use primarily image-based tasks, were not included unless they shed light

on the main topic of interest. Reviewed articles were assessed for major focal points as described above. Articles are over-sampled where they pertained to less-developed areas of research.

Results

Measurement of self-referent bias

Measuring self-reference has focused on the SRET (Derry & Kuiper, 1981; Rogers et al., 1977). The SRET asks participants to respond to positive and negative adjectives presented singly on a screen, while reaction time is measured. After responding to the words, some studies also ask participants to provide a free recall of the words, usually after a distractor task.

The prompt that participants are responding to is "Does this word describes me?" or some variant thereof. Participants have also been asked to respond to whether the word describes some other figure (i.e., whether the word is other-referential) or is semantically similar to another word (i.e., a distractor task) (e.g., Derry & Kuiper, 1981; Greenberg & Alloy, 1989). For the purpose of this review, I will primarily focus on the self-referent encoding task, with some comparison to studies that make use of the other-referent protocol. Other-referent tasks are diverse, including e.g. a "well-known other" (e.g., B. P. Bradley & Mathews, 1983; Kuiper & MacDonald, 1982); famous individuals such as U.S. Presidents Bill Clinton (Shestyuk & Deldin, 2010) or George Bush (Kelley et al., 2002), or Queen Elizabeth (Sarsam et al., 2013); or even an unfamiliar person (e.g., B. P. Bradley & Mathews, 1983; Dalgleish et al., 2004). A discussion with a deeper focus on other-reference (including as it compares to self-reference) can be found elsewhere (Collins & Winer, 2023).

The SRET has numerous parameters, beginning with endorsement (yes or no to the "describes me?" question) and reaction time (RT), or the latency to response. Additionally, recall of the presented words is often used, and I will give an overview of the parameters here, as well as a discussion of some modifications of these metrics used in some case, including a processing bias and computational model scores.

Endorsements

The binary decisions made by participants when responding to whether words describe them are reported as endorsements on the SRET. Generally, endorsement of positive words as self-referent indicates a more positive self-worth, while endorsement of negative words as self-referent indicates negative self-perception or worthlessness. As such, predictions suggest that depressed participants will endorse more negative and fewer positive adjectives compared to non-depressed participants. Most studies do indeed show this to be the case (Dainer-Best et al., 2017; Dobson & Shaw, 1987). Depending on specifics of the word list, within-participant differences may not indicate that more negative than positive words are endorsed, especially for highly negative and moderately positive words. For example, mildly depressed individuals would be less likely to endorse words such as *worthless* or *hateful*, and may happily endorse positive words such as *free* or *nice*. Indeed, individuals with elevated depressive symptoms sometimes endorse more positive than negative words (Disner et al., 2017). Endorsements may indicate differences between participants, i.e., distinguishing by self-worth. Many studies using the SRET report endorsements broken up as positive or negative. Strong correlations may be present between depressive symptoms and negative endorsements (positive correlation) and positive endorsements (negative correlation) (Dainer-Best, Lee, et al., 2018).

Comparisons of endorsements of positive and negative words between published studies presents some challenges, especially relating to word lists. Not all published studies of the SRET include the full word list. Some describe concepts behind their creation, e.g., Dozois and Dobson (2001a) report choosing interpersonal adjectives, Pincus et al. (1995) report choosing pain-related stimuli as well as depression-related and neutral, and Alloy et al. (1997) report including words that were positive or negative, as well as depression-relevant or -irrelevant. Additionally, other work divides adjectives into control ("cooperative"; "crude") as well as anxiety- and depression-relevant positive and negative adjectives (Greenberg & Alloy, 1989).

Although these specific aspects relating to positive and negative adjectives are important, many other studies simply report using positive and negative adjectives. Studies also indicate choosing words from the Affective Norms for English Words (ANEW; M. M. Bradley & Lang, 2010), which enables them to match stimuli for valence, arousal, and frequency (e.g., Auerbach et al., 2015; Disner et al., 2017; Shestyuk & Deldin, 2010). Other studies have used words from other corpuses (including Anderson, 1968; Doost et al., 1999) or pulled adjectives from scales measuring depression (as in Derry & Kuiper, 1981).

A meta-analysis of SRET research, across 21 samples and 640 participants, found no significant differences in endorsements of positive and negative self-referential stimuli in depressed individuals, although there was a significant effect in those with severe levels of depression (Collins & Winer, 2023). However, non-depressed participants endorsed more positive than negative words. These findings suggest that even if (as discussed above) word lists differed between studies, depressed participants showed a different pattern from those who were not depressed. And, indeed, the meta-analysis also concluded that depressed individuals generally endorsed fewer positive words and more negative words than those who were non-depressed (Collins & Winer, 2023).

This result indicates that endorsements should be evaluated as compared to a non-depressed sample, not solely by an expectation that depressed individuals will endorse more negatively than positively.

Reaction time

Theoretically, latency on the SRET in response to adjectives of different valences should differ based on depressive schema, given that a schema is the lens through which information may be processed (Segal & Swallow, 1994). However, it remains to be shown whether RT is revealing of a psychological state (i.e., reflects meaningful differences in processing) or is simply a function of the delay of response that sometimes occurs in depression (Siegle et al., 2001; Sobin & Sackeim, 1997). Findings about RT have been mixed (Collins & Winer, 2023; Dainer-Best, Lee, et al., 2018). While some studies have indicated *slower* RT in response to self-referential adjectives in those with increased depressive symptoms (Dozois & Dobson, 2001a; MacDonald & Kuiper, 1985), others have found *faster* RT for high-risk depression participants in response to self-referential adjectives (Alloy et al., 1997) or faster RT for depressed participants in self-referential negative stimuli compared to non-self-referential (MacDonald & Kuiper, 1985). Quite a few others have found no major association between RT and depressive symptomatology (B. P. Bradley & Mathews, 1983; Dainer-Best, Lee, et al., 2018; Dobson & Shaw, 1987; Gotlib et al., 2004).

A meta-analysis, across 437 participants and 15 samples, found no significant differences between RTs to positive or negative self-referential words for depressed participants, nor (over 10 samples) for non-depressed participants (Collins & Winer, 2023). Similarly, no RT differences appeared in this meta-analysis between depressed and non-depressed participants when it came to positive words. However, they found a significant effect where RT to negative words was increased in depressed participants, over 11 samples and 449 participants, which appeared to be rooted in the responses of severely-depressed participants (Collins & Winer, 2023). Indeed, these results align with neuropsychological findings that depressed participants seem to differentially process negative adjectives (e.g., Auerbach et al., 2015; Dainer-Best et al., 2017), as discussed further below.

One important distinction to note is that many studies which report RT in response to the SRET have reported RT to all positive and all negative words (e.g., Dainer-Best, Lee, et al., 2018; Fritzsche et al., 2010), whereas others specifically report RT to self-referential positive and negative words (Alloy et al., 1997; Dozois & Dobson, 2001a; MacDonald & Kuiper, 1985). This distinction makes comparison across studies difficult. In general, RT appears to provide limited information, mostly in comparison to responses to negative words (Collins & Winer, 2023).

Memory: Recall and self-referential recall

Recall of the adjectives presented during the behavioral SRET has been used to understand whether there are differences in positive or negative recall. Indeed, as discussed below, the SRET has sometimes been viewed as a measure of memory bias in depression. Recall is improved when stimuli which have been engaged with in an individual's conscious thought—not just visually noted but engaged with in some deeper way (i.e., *encoded*) (Craik & Tulving, 1975). Self-referential stimuli are also easier to recall than those which are not self-referential (Bentley et al., 2017; Kim et al., 2022). Thus, researchers conclude that terms which are present in the free recall, and were described as self-referential during the behavioral task, are indicators of schema activation. Thus increased recall of negative words indicates a more negative self-schema, and increased recall of positive words a more positive self-schema. Recall of items on the SRET is usually collected as a free recall of any of the words presented, either immediately following the administration or after a brief distractor task, resulting in positive/negative recall scores. To my knowledge, no study has investigated whether recall is differentially related to depressive symptoms if a distractor is used. I suggest that the distractor primarily decreases the number of words recalled.

In general, studies have shown that depressed participants recall more negative and fewer positive total words than non-depressed participants (Derry & Kuiper, 1981; Dobson & Shaw, 1987; Dozois & Dobson, 2001b; Timbremont & Braet, 2004). Additionally, there is evidence that depressive symptoms are negatively correlated with recall of positive words and positively correlated with recall of negative words (B. P. Bradley & Mogg, 1994; Dainer-Best, Lee, et al., 2018). Strong evidence has made it clear that recall was significantly better for specifically self-referent stimuli than other-referent or semantic tasks (Symons & Johnson, 1997). Symons and Johnson (1997) conclude that a self-referent effect exists due to the elaborative process of evaluating information "through" the self. This conclusion is mirrored by another review which differentiates between self-reference and elaborative processing models, suggesting that both may explain portions of how information is processed in depression (Wisco, 2009).

Memory bias scores for the SRET are calculated by dividing the number of self-referent words of each valence recalled by the number of words of that valence endorsed (Dainer-Best, Lee, et al., 2018; Hayden et al., 2013; Johnson et al., 2007). Thus if 10 positive words were endorsed and then 5 recalled, a ratio of 5/10 or .5 might be the score. These ratios are highly influenced by floor effects. For example, a non-depressed participant may endorse close to zero negative words, resulting in a memory bias score of zero even if they recall many negative words, or an unusable ratio if they endorse no negative words and thus have a denominator of

0. (This issue has been considered before, see Prieto et al., 1992) On the other hand, a different non-depressed participant who endorses one negative word and then recalls it may receive a memory bias score of one—the same score as a depressed participant who endorsed 10 negative words and recalled each. Similarly, if recall is not focused on self-referent words, then depressed participants may experience impaired recall due to depressive symptoms (Burt et al., 1995; Rock et al., 2013), thus seeing lower recall in general than non-depressed individuals. Due to this concern, some studies have calculated a processing bias ratio of positive and negative adjectives endorsed and recalled to all words endorsed (Goldstein et al., 2015; Prieto et al., 1992; Speed et al., 2016). Such ratios have not been compared directly to the other parameters because they run the risk of linear dependency (Dainer-Best, Lee, et al., 2018), although one study found them not to be collinear with endorsements (Prieto et al., 1992). These studies find similar trends with these ratios, with depressed participants likely to have no difference between recall ratios for positive and negative words (Prieto et al., 1992) or for high-risk participants to show an increased recall for negative (Speed et al., 2016).

A meta-analysis, across 504 participants and 20 samples, found that depressed participants were more likely to recall self-referential negative words compared to positive, whereas the opposite effect was found for 15 samples that included non-depressed participants (Collins & Winer, 2023). When comparing depressed to non-depressed participants, depressed individuals recalled fewer positive and more negative words. These results are in line with a broader meta-analysis of memory bias in depression, which found explicit memory biases in participants with histories of depression, including on the SRET (Everaert et al., 2022). These results also explain the fact that across SRET studies in the meta-analysis, depressed participants recalled more negative words than non-depressed participants—despite impairments in recall seen in MDD. However, the comparison between depressed and non-depressed participants may also be confounded by endorsement floor effects as described above.

Some studies in children and using neuroimaging methodologies have also collected data on recognition (rather than recall) of SRET words (e.g., Miskowiak et al., 2018; Prieto et al., 1992). These studies have shown similar patterns to those of recall, but bear future investigation.

Computational models of self-reference

A recent focus has used mathematical models, primarily the drift-diffusion model (DDM; Ratcliff & Rouder, 1998; White et al., 2010), to model the binary choices made during the SRET and memory decisions. This approach focuses on the SRET as a decision-making process where evidence accrues until the criterion is met at which point a decision (self-referent or not self-referent) is met (Disner et al., 2017). The DDM attempts to separate cognitive decisions from motor or other non-decision processes using reaction times and binary decision responses. This inclusion of information from both reaction time and decisions is key to the DDM's utility.

Among a number of other parameters, the DDM estimates the drift rate, which indexes how strongly a stimulus impacts decision-making, integrating both reaction time and response (Dainer-Best, Lee, et al., 2018). For example, a strongly positive drift rate to positive adjectives indicates that such words are easily categorized as self-referential, while a strongly negative drift rate to positive adjectives indicates that they are easily categorized as not self-referential. A drift rate close to zero indicates that words are difficult to categorize. These parameters provide the ability to draw conclusions from the SRET about patterns of behavior, and they have been shown to be highly associated with measures of depressive symptoms (Dainer-Best, Lee, et al., 2018), although not gaining in predictive validity for future symptoms when compared to other components of the SRET (Disner et al., 2017).

Since applying the DDM to the SRET, others have also used a similar methodology across several domains. Beevers et al. (2019) used random forest analyses to show that specific depressive symptoms including sadness, self-dislike, and pessimism were associated with the drift rate parameters. Other research has found a continuum of depressive symptoms associated with drift rate parameters (Hitchcock et al., 2023). Work from Allison et al. (2021) used a hierarchical DDM to compare adolescents who had made suicide attempts or experienced suicidal ideation, and found no major differences between groups on drift rate. Another study focused on a hierarchical DDM relating to memory for SRET words, and found that depression symptoms were associated with increased efficiency of evidence accumulation relating to the memory for negative words (Cataldo et al., 2023). Finally, recent work has shown connections between SRET drift rate and social anxiety (Castagna et al., 2022, 2023) or change in a mindfulness-based trauma recovery paradigm (Aizik-Reebs et al., 2022). Such approaches hope to gain specificity and insight into the decision-making process being undergone in the choice of whether words are self-referential. Whether the information gain is significant beyond the long-used output of the SRET remains to be seen, although some work has attempted to determine that distinction (Dainer-Best, Lee, et al., 2018).

Given the significantly slower RTs to negative words found for depressed vs. non-depressed participants in a recent meta-analysis (Collins & Winer, 2023), it is possible that this explains the increased evidence for drift rate as a parameter that is associated with depressive symptoms. However, the drift rate and other parameters from the diffusion model have not been included in meta-analyses as of this time. It is possible that as more studies include DDM analysis, a conclusion as to its utility may become apparent.

Memory biases

An initial focus of the research on self-reference, beyond endorsements or RT, was as a measure of memory bias in depression (B. P. Bradley & Mathews, 1988; Hammen & Zupan, 1984; Mineka & Nugent, 1995; Pincus et al., 1995; Vrijsen et al., 2015, 2019; Zupan et al., 2017). As argued in a meta-analysis from the 1990s, self-referent encoding of information improves recall across a range of studies (Symons & Johnson, 1997). That is, the self-reference effect is not simply asking "does this describe me?" but also answering that it does. This effect has repeatedly been shown across many studies (Bentley et al., 2017). Self-referent encoding appears to increase elaborative processing and sustained engagement with stimuli (Wisco, 2009). Some evidence shows that across a variety of stimuli, depressed individuals are likely to recall both more negative stimuli and less positive (Matt et al., 1992). Measures of explicit memory in depression appears to be biased across adults and children, and across ranges of depressive symptomatology (Everaert et al., 2022; Gotlib & Joormann, 2010).

The self-reference effect may also be viewed as a family of effects, depending upon how the self is defined and how memory is measured (Klein, 2012). Klein (2012, p. 286) distinguishes between the self of personal experience ("ontological") and the self defined by cognitive or neurological study ("epistemological"), arguing that the ontological self can only be inferred while the epistemological self can be studied. The self that can be studied is thus based on one's own history and memory of oneself. The SRET thus provides the ability to study the role played by the self in memory, through the recall of the presented words. The self-reference memory effect may work through elaborative processing (encoding based on considering individual items) or organizational processing (placing the SRET words in reference to others), or through a combination of both (Klein, 2012; Symons & Johnson, 1997). Klein (2012) also distinguishes between autobiographic self-referential recall studies and those using the SRET, and argues that the SRET conducted using descriptive adjectives is most consistent in producing a self-reference effect.

Some research on memory bias has relied on the SRET as a means of identifying negative self-schema. In particular, the SRET may identify a negatively biased memory, as indexed by recall of the self-referent negative adjectives or lack of positive recall. Consistent evidence points to the negative memory bias as being present in depression (B. P. Bradley & Mathews, 1988; Mathews & MacLeod, 2005; Sanz, 1996). As a corollary of this bias, recall on the SRET has also been used as an indicator of negative memory bias as described above. Similarly to only using word endorsements, the memory bias aspect of the SRET can be used on its own, but may benefit most from being thought of as only one component of a variety of biases in depression, thinking along the lines of the combined cognitive bias hypothesis (Everaert et al., 2012). Continuing to integrate memory bias with other cognitive biases, including biased self-reference indexed by the diffusion model or endorsements, is important in making the most of the SRET and fully understanding self-schema.

Neuroimaging and electroencephalography

Studies have explored self-referent processing using both functional magnetic resonance imaging (fMRI; Butterfield et al., 2023; Fossati et al., 2003; Kelley et al., 2002; Miskowiak et al., 2018; Nam et al., 2022), positron emission tomography (PET; Craik et al., 1999), and electroencephalography (EEG; Auerbach et al., 2015, 2016; Dainer-Best et al., 2017; Kiang et al., 2017; Shestyuk and Deldin, 2010; Speed et al., 2016). Reviews have found difficulty in identifying one or several locations in the brain that define the self (Butterfield et al., 2023; Gillihan & Farah, 2005), which may be because of a variety of paradigms or because the self is too complex of an entity to be localized in this way (Klein, 2012). However, some brain structures are activated by self-related tasks (Northoff et al., 2006). Such studies are frequently conducted with very small samples, although this is common in the older fMRI literature. Many of these studies are focused broadly on identifying self-referent processing rather than on self-referent processing in depression. A review of self-reference across different disorders suggests that findings show depressed participants to be engaged more deeply with negative stimuli, and unable to decenter from those stimuli (Frewen et al., 2020).

Studies using fMRI found activation during self-referent processing of the right dorsomedial prefrontal cortex (Fossati et al., 2003), as well as the medial prefrontal gyrus, posterior cingulate gyrus, and precuneus (Yoshimura et al., 2009). In depressed participants, studies have shown activation in the medial prefrontal cortex (mPFC), as well as the anterior cingulate cortex (ACC) and the amygdala (Craik et al., 1999; Li et al., 2017; Macrae et al., 2004; Sarsam et al., 2013; Yoshimura et al., 2010). The mPFC is involved in emotional responses as well as associative learning (Euston et al., 2012), and it is unsurprising that it would be implicated in self-referent processing. Additionally, in a treatment study conducted in 23 depressed participants, improvement was associated with changes in how the mPFC and ventral ACC were activated when participants completed a version of the SRET (Yoshimura et al., 2013). The role of the mPFC has been underscored in reviews (Nejad et al., 2013), suggesting it to be an important structure in self-referent processing; however, its role within the context of depressive self-referent processing—how it is differentially engaged in depressed individuals—may bear further scrutiny.

Findings from the event-related potential (ERP) EEG literature have been mixed in terms of early components, related to the early stages of attention. Negative compared to posi-

tive self-referent items elicited greater early components (P1, P2) in some research (Allison et al., 2021; Auerbach et al., 2015; Shestyuk & Deldin, 2010) but this effect did not appear in other studies (Dainer-Best et al., 2017; Speed et al., 2016). Such conclusions bear further scrutiny in meta-analyses or future ERP-based reviews of the SRET.

A more consistent finding has been that of markers of effortful encoding or elaborative processing in response to negative words more than positive words, especially the P3 and late positive potential (LPP; Auerbach et al., 2015; Dainer-Best et al., 2017; Shestyuk & Deldin, 2010). These findings suggest a sustained attention to negative information which is heightened during MDD or when experiencing depressive symptoms. The increased LPP in response to negative words for depressed participants has not been shown in comparison control samples of healthy participants (Auerbach et al., 2015; Dainer-Best et al., 2017; Shestyuk & Deldin, 2010; Speed et al., 2016). A study of adolescent suicidal ideaters and attempters found no difference between groups on the LPP (Allison et al., 2021). Additionally, depressed participants in a different study showed smaller waveforms compared to controls in response to a waveform elicited by meaningful stimuli (the N400) which is reduced when the stimulus has already been presented (Kiang et al., 2017). They argued that this smaller N400 in depressed participants results from the strong link between negative stimuli and the self in those individuals. Finally, there have also been some indications that this increased engagement may not be present in all samples (Waters & Tucker, 2016). This study did, however, have meaningful differences from the others, as it used a word list focused on personality characteristics that may have been less activating for depressed participants (Waters & Tucker, 2016). In general, this thrust of research provides evidence for top-down control of affective stimuli (Comblain et al., 2005), which also provides the suggestion that self-referent processing may be targeted for assessment or intervention.

Changes in and stability of self-reference

From the first, a longitudinal understanding of depression's relationship to self-schema has been warranted. Evidence quickly came that self-reference might change when individuals were no longer depressed (Dobson & Shaw, 1987). In a small study of 53 individuals (24 depressed), Dobson and Shaw (1987) showed that responses to the SRET were specific to depression—both in that those depressed participants differed from non-depressed controls and in that their responses on the SRET changed dramatically when their depression remitted (in the subsample who remitted, $n = 14$). These results are in line with research which shows that cognitive distortions and biases associated with depression are sequelae rather than antecedents (Barnett & Gotlib, 1988; Lewinsohn et al., 1981). Later work has showed similar results, with both SRET endorsements and recall remaining stable over six months for 22 depressed participants but improving for 23 participants with remitted symptoms (Dozois & Dobson, 2001b). In particular, remitted individuals showed an increase in positive endorsements and a decrease in negative endorsements, whereas endorsements were quite consistent for those who remained depressed.

These studies seem to confirm the understanding of remission from depression as being a return to a healthier self-schema—that is, of an individual's self-reference being mood-dependent. However, individuals with remitted depression did not show a statistically-significant decline in memory bias for negative words (Dozois & Dobson, 2001b). Although this may be the result of insufficient statistical power, and suggests the utility of larger-scale longitudinal data collection in depressed samples, a meta-analysis did find evidence that memory biases in depression persist in remitted samples (Everaert et al., 2022).

Over the course of a week, the various components of the SRET have been shown to be quite stable in an unselected, online, community sample of adults ($n = 167$), with no regressions showing significant effects of time on any of its components, and correlations for endorsements over $r = .8$ (Dainer-Best, Lee, et al., 2018). However, while some participants were depressed in this sample, many were not; similar large-scale work in the future may choose to focus on repeated assessment over a longer period of time, while also including clinical assessments. Research has also found the SRET to be relatively stable in a sample of children in the 6–9 age range (Goldstein et al., 2015; Hayden et al., 2013), although there may well be development of the self-schema during this time (Dozois & Beck, 2008). Work has also shown stability on both behavioral and event-related potential measures of the SRET in adolescents (Auerbach et al., 2016). A longer-term study, which followed adolescents over a seven-year period, found a slight increase in negative self-schema while positive self-schemas remained stable (McArthur et al., 2019). While such long-term prospective research is rare, it underscores the importance of both negative and positive information in determining self-reference.

In cross-sectional work, measures of self-reference have found similar patterns in children to adults from the first (Hammen & Zupan, 1984). Thus another perspective on the change of self-reference has been asking questions that use the SRET as a baseline marker: does self-reference at one timepoint predict future depressive symptoms, or can an intervention change self-reference? Such studies have largely focused on depression risk. A comparison of high-risk to low-risk participants found that those which showed highly negative self-referent processing had a higher prospective incidence of depression (Alloy et al., 1999). Additionally, viewing self-reference as an outcome, childhood emotional maltreatment showed increased bias in self-reference (Steinberg et al., 2003). Negative bias on the SRET has been shown

to predict depressive symptomatology in children and adolescents (Connolly et al., 2015; Disner et al., 2017; Friedmann et al., 2015) and suicidal ideation in girls (Burke et al., 2016).

The SRET can also be viewed from the standpoint of a marker of change in intervention research. Studies that have used self-referent processing as such have found reduced negative self-reference and increased positive self-reference following treatment for social anxiety disorder (Goldin et al., 2013; Thurston et al., 2017), trauma recovery (Aizik-Reebs et al., 2022), and depression (Quilty et al., 2014). In another study of adults, depressed adults who received cognitive therapy in conjunction with pharmacotherapy saw improvement in positive and negative self-schemas that was not observed in people who received pharmacotherapy alone (Dozois et al., 2009). Another study found that a positive imagery training resulted in an increase in positive self-referent processing as well as a decrease in negative (Dainer-Best, Shumake, & Beevers, 2018). Other work has also shown, using a diffusion model, that evidence accumulation for positive endorsements change following a mindfulness intervention (Hitchcock et al., 2023). This work found differing accumulation according to a drift-rate diffusion parameter after the intervention, with changes in the predicted parameter correlated with changes in depression. Taken together, these results indicate that the SRET may be a useful marker for treatment research which focuses on self-schema or self-reference, as well as in other topics that may involve self-referent processing (Lin et al., 2018).

Such research could most benefit by the inclusion of the SRET in a variety of treatment studies; including measures of self-reference before, during, and/or after interventions could greatly increase our information relating to how these processes change and are changed by improvement. Such studies may also provide additional evidence for whether self-schema and self-reference are causal in depressive symptoms of the diminution of such symptoms. Because the SRET is a marker for multiple aspects of the cognitive biases present in depression, it could provide useful information to researchers conducting clinical trials as well as those studying self-schema.

Self-reference and personality

Self-esteem has long been theorized to play a role in depressive self-image, with the evaluative processing of information about the self resulting in that self-esteem (Beck & Bredemeier, 2016). The negative self-esteem in depression can result in feelings of worthlessness or self-doubt, which play a role in changing self-referential processing. The self-schema thus includes within it a component of self-esteem as well as the specific component of self-reference. One view argues that self-esteem and self-reference could be included within a general construct of self-knowledge (Lou et al., 2019), which might itself be viewed as contained within Beck's self-schema. Many researchers have also linked self-reference to dysfunctional attitudes (Weissman & Beck, 1978); such work demonstrates a link between negative self-referent beliefs and vulnerability to depression (Moilanen, 1993).

In general, self-esteem is a similar concept to self-reference, and researchers have questioned their association. Negative self-esteem has been associated with highly positive drift rate for negative adjectives on the SRET, i.e., less evidence needed to endorse negative adjectives as self-referent (Castagna et al., 2022). Others have shown that implicit self-esteem may connect explicit self-esteem to self-referent memory biases in MDD, using a Go/No-go Association Task (Romero et al., 2016). That is, both one's own belief about one's self-esteem and an implicit measure of it play a role in recall of SRET adjectives.

In a review discussing what its authors refer to as self-knowledge in depression, Lou et al. (2019) argue for a difference between implicit self-knowledge—i.e., that measured by the implicit association test (Greenwald et al., 1998)—and explicit self-knowledge as measured on the SRET. Implicit measures are distinct from the elaborative processing that occurs during the SRET. However, it is probable that self-esteem, implicit or otherwise, overlaps with self-reference and with depression generally (Hankin et al., 2007). Self-reference theoretically encompasses a broader understanding that extends beyond solely worth or worthlessness. One might argue, however, that self-esteem may itself be a component of self-schema, if self-schema is primarily viewed as a model of understanding through the self. In general, replication may be important for disentangling these related concepts.

Discussion

Concerns about the Self-Referent Encoding Task

One important question regarding the SRET and the self-reference effect is its context within cognitive theory. Much as Klein (2012) argues for a "family" of self-reference effects, it is important to note that many variants on the self-referent encoding task exist, from those measuring self-reference through different questions (e.g., Miskowiak et al., 2018) to those that appear to be an SRET but are focused on other questions than mental health (Williams et al., 2022). (Additionally, a subset of studies which I discuss here refer to a self-referent information processing battery Alloy et al., 1997, 1999.) I argue that the SRET provides a useful measure of both self-schema and memory bias in depression. The basis of self-reference as a determining factor in understanding depressotypic thinking should also be questioned. Although there is a theoretical basis in cognitive theory (Beck, 1979; Dozois & Beck, 2008), objective evidence

for the link between self-reference (or self-schema) and depressive symptoms is harder to define. Beck and others have worked to provide empirical evidence for the cognitive theory (e.g., Beck & Haigh, 2014; Haaga et al., 1991). Evidence for self-schema may not, however, translate into evidence for self-reference as a component of it; this is a theoretical argument that forms the foundation for this literature.

Beyond theory, recent work has demonstrated strong psychometric properties for the SRET (Auerbach et al., 2015; Bentley et al., 2017; Dainer-Best, Lee, et al., 2018). However, the utility of the SRET as a marker that changes due to depressive symptoms and not other factors could use further evidence. Since the awareness of a need for replication in psychology has increased in the past decade (Open Science Collaboration, 2015; Pashler & Wagenmakers, 2012; Simmons et al., 2011), researchers studying self-reference have also increasingly included replication with analyses. Many of the early studies of the SRET were conducted in small samples (e.g., Derry and Kuiper (1981) used 16 participants per group). Although many early SRET studies have replicated in later work, these small samples still appear in meta-analyses of the SRET literature (Collins & Winer, 2023; Symons & Johnson, 1997). However, few of the studies that enrolled larger sample sizes (e.g. Bentley et al., 2017; Dainer-Best, Lee, et al., 2018) have specifically studied participants who met a clinical criterion for MDD.

One concern that remains regarding the SRET's psychometric properties is its divergent validity. In general, many of the concepts involved in understanding depression have high levels of overlap (Hankin et al., 2007). There are high correlations between symptoms of anxiety and depression, and we thus often refer to them as disorders of negative affect (Watson, Clark, & Carey, 1988). Some research has attempted to determine which symptoms of depression are most able to explain variance in self-reference, identifying sadness and self-dislike and several others (Beevers et al., 2019), although other research did not replicate the connection with those specific symptoms (Hitchcock et al., 2023). This invites future replications in both cross-sectional and longitudinal research.

Future directions and clinical implications

As work continues to make use of studies of self-reference, there are additional future directions, beyond those discussed above, which provide the potential for gaining insight into the SRET and self-referent processing. I discuss some below, including potential hypotheses they may generate.

Lou et al. (2019) argue for a cross-cultural analysis of the SRET, including questions of whether self-reference is processed differently between cultural groups. While some work discussed above uses non-WEIRD samples (Henrich et al., 2010), much of it does; asking questions comparing between such groups provides one outlet for future work. Future samples for self-reference research should also be heterogenous, providing the opportunity to ask questions about specific demographics (Aguirre et al., 2022) or specific symptoms of depression (Beevers et al., 2019).

An important direction for future research that engages with the SRET and self-reference is using them to identify features of therapy—online or otherwise—that are effective for given expressions of symptoms. Similarly, identifying which features of behavior maintain depressive symptomatology would help identifying which should be targeted, and self-reference may be linked to some of these behaviors. Work that identifies how the SRET changes over time—rather than just whether it changes—should continue to link it to depressive symptoms as well as specific components of depression. Similarly, identifying mechanisms of change when depression worsens or ameliorates are important steps. The SRET has the potential to be specific as a target, although it has been used sparingly (e.g., Aizik-Reebs et al., 2022; Dainer-Best, Shumake, & Beevers, 2018; Dozois et al., 2009; Hitchcock et al., 2023; Lin et al., 2018; Quilty et al., 2014). Such analysis provides the opportunity to ask causal questions about self-reference as well as to interrogate how memory and attention change with self-schema.

Although it has been discussed above, the associations between self-reference and other measures of cognitive bias and self-schema should continue to be explored. This includes interpretation biases (Everaert et al., 2012, 2017) and attention biases (Marchetti et al., 2018), as well as broader questions of the umbrella of depressive functioning (Hankin et al., 2007). Future work should also focus on continuing to define the exact nature of self-reference (if not of the self). We often describe separate constellations of symptoms in depression, which include physical and cognitive symptoms (Chekroud et al., 2017; Fried, 2017; Fried & Nesse, 2015). Identifying which of these constellations overlap with self-referent processing, or are implicated in biased processing, will continue to provide clinical researchers with models to test.

The SRET is not a clinical instrument. Nonetheless, it has been heavily used in studies with clinical samples. In this review I have largely synthesized work that used community samples, those that used samples with elevated depressive symptoms, and those that specifically targeted participants diagnosed with MDD. Importantly, many of the findings with the SRET hold true not solely with patient samples but also for the general population who are experiencing depressive symptoms. Clinical psychology is not without diagnostic instruments, although linking symptoms with outcomes is difficult (Fried & Nesse, 2015). The SRET will not replace these instruments. However, it remains a useful marker of self-schema and biased self-reference. Nonetheless, the findings that implicate both elaborative and organizational process-

ing in determining information to be self-referential have the potential to impact cognitive treatments: it is important for patients to consider how negative self-evaluation does more than simply affect the moment, but also has deeper reach.

Conclusions

The self-referent effect continues to be an important topic for psychology. Self-reference can bias memory towards negative information in depression, while also diminishing attention to positive information. Such self-referent processing appears to relate to both early attentional processing and later elaborative processing according to event-related potential research. It also engages some structures in the brain including the medial prefrontal cortex (mPFC), involved in emotional responses and memories. The SRET has good stability over time in healthy individuals, but appears to change with changes in schema or response to intervention. And while there is some overlap with dimensions of personality, including self-esteem, studies suggest self-reference to be a general method of viewing the self.

As further work explores self-reference's utility to interventions for depression—and other disorders—this work will continue to benefit from attention to the SRET, and the understanding of the concepts that underlie it. How we refer to ourselves will continue to be relevant to clinical researchers—and to provide a space for those interested in helping individuals experiencing depression.

Acknowledgments

I thank Rahel Pearson for comments, and research assistants in my lab including Gabriel Traub and Cam Goldberg for their discussions of several articles included in this review.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The author declares no conflicts of interest.

Author contribution: J. Dainer-Best was the sole author of this article and was responsible for conceptualization, methodology, analysis, and writing.

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