Thought-Action Fusion and Psychopathologies: A Review of Literature

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Abstract

Thought–action fusion (TAF) can be defined as the tendency to equate the thought of an action with the realization of the action. This article reviews the present literature on TAF. Many studies over thirty years have been conducted to investigate TAF and its relationship with various psychopathologies. Emanating from OCD literature, TAF was also found to be present in anxiety disorders, depression, schizophrenia, and eating disorders. The recent neuroscience studies on TAF suggest that precuneus, lingual gyrus, caudate nucleus, and several frontal and occipital cortex regions are activated during TAF experiences. The findings were discussed in terms of TAF’s specificity to OCD, the possible role of mental imagery in the formation of TAF, and suggestions for further research were made.

Keywords: thought-action fusion, magical thinking, obsessive-compulsive disorder, anxiety disorders, mental imagery.

Introduction

This review article aims to examine the concept of Thought-Action Fusion (TAF) in-depth and explore its relationships with Obsessive-Compulsive Disorder (OCD) and other psychopathologies. TAF can be briefly defined as one's belief that the thought of an action is enough for one to experience it as though the action has already occurred in real life (Shafran & Rachman, 2004). It supposes that thoughts have a special power and causal impact on external reality (Rachman, 1993; Freud 1909). Basically, TAF has two components, likelihood and morality (Shafran et al.,1996a). TAF-Likelihood refers to the experiences that the thought of an action increases the probability of the realization of the action, while TAF-Morality covers the experiences that the thought of an immoral action is seen as equivalent to carrying out the immoral action. Having been studied as a cognitive appraisal or belief, TAF has received considerable research attention, particularly since the 1990s. However, the origin of the concept can be traced back to the 1900s, to the observations of anthropologists, psychoanalysts, and developmental psychologists.

In the context of OCD, the negative repetitive thoughts appear in one's mind and disturb the individual as if the harmful action in the thought is taking place in the external world (Shafran & Rachman, 2004). For example, when a person thinks that an acquaintance will get sick, the person may feel a personal responsibility for the illness, supposing that she/he lets it happen. Although it was assumed that TAF is predominantly seen in people with OCD, the studies have shown that TAF is at least as related to other psychopathologies like generalized anxiety disorder, social anxiety disorder,, depression, eating disorders, and psychotic disorders as OCD (Berle & Starcevic, 2005). Moreover, several experimental results suggested that TAF like experiences

could be induced in healthy participants (Lee et al., 2020; Rassin et al., 1999). These findings further question the specificity of TAF to OCD.

A point rarely remarked in TAF literature is that anthropologists, psychoanalysts, and developmental theorists had mentioned some concepts about TAF (albeit broader) long before it appeared in cognitive psychology. From the beginning of the 1900s, many thinkers asserted that early societies experienced their animist beliefs and magical endeavors through the power of thoughts, which can influence events in external reality, commonly referred to as “magical thinking” (MT). Lévy-Bruhl (1910/2018), Freud (1909, 1913), and Piaget (1929) intensively wrote about their observations regarding MT in native people, obsessive patients, and children. The researchers generally define MT as a broader concept than TAF, comprising unnatural causality inferences beyond culturally accepted explanations (Bocci & Gordon, 2007). Bolton et al. (2002) described magical thinking as a process that “typically involves the attribution of causal effects on real events by either thought or an action that is physically unconnected to the events.” (p. 479). In this sense, it is possible to regard TAF as an extension of magical thinking (Amir et al., 2001; Einstein & Menzies, 2004a, 2004b).

In this review, several features of TAF and related concepts will be addressed. First of all, the emergence and development of TAF in cognitive psychology literature will be reviewed. Second, several hypotheses regarding the origins of TAF experiences will be examined. Third, the relationship between TAF, OCD, and other psychopathologies will be mentioned. Fourth, the ways of inducing TAF in experimental settings and interventions for reducing TAF will be addressed. Fifth, recent research regarding the brain mechanisms of TAF will be overviewed. Finally, a general discussion and conclusion of the issue will be given.

Cognitive Psychology and TAF

The emergence of TAF as an important concept in literature has derived from the studies conducted over the last 30 years. In the course of studying OCD, some clinicians noted the sense of inflated responsibility found in OCD patients (Freud, 1894; Rachman, 1973, 1993; Salkovskis, 1985; Salkovskis et al., 1995). In some cases, the sense of responsibility was so much that people felt responsible for crimes they had no relation to and even went to the police to confess to these crimes they have never committed (Rachman, 1993).

Cognitive psychologists asserted that the perception of excessive responsibility in OCD may stem from the patients' maladaptive beliefs and threat appraisal errors (Carr, 1974; McFall & Wollersheim, 1979; Salkovskis, 1985). In his seminal paper on OCD, Salkovskis (1985) discussed that the sense of inflated responsibility is caused by various assumptions by the person, which were listed as follows: (1) the person equates the thought of an action with the realization of it; (2) the inability to prevent the harm that happens to any person is seen as equivalent to harming that person; (3) there are hardly any other factors that will reduce the responsibility of the person in the situation; (4) the inability of a person to neutralize his/her unwanted negative thought is seen as equal to the realization of the harm that is in the content of thought; (5) one must have control over one's own thoughts (Salkovskis, 1985). Another contributing factor to OCD, which was proposed by Rachman (1998), is the catastrophic misinterpretation of intrusive thoughts. Rachman (1998, p. 216) gave an example of this process:

“If I interpret my unwanted intrusive images of violence as revealing some important, deep propensity or flaw in my personality that makes me potentially dangerous, then knives are transformed from neutral cues into danger cues, the sight of knives acquires the power to trigger the obsessions.”

In brief, it was proposed that all these appraisals and misinterpretations in OCD patients make them undertake personal responsibility for an unrealized action that only appeared in their thoughts and promote TAF experiences.

To measure the sense of inflated responsibility in OCD patients, Rachman, et al. (1995) developed the Responsibility Appraisal Questionnaire. The scale was found to have a four-factor structure, and these factors were named as responsibility for harm, responsibility in social contexts, positive perspective towards responsibility, and thought-action fusion. In their follow-up study, the researchers revealed that only the thought-action fusion subscale was associated with various sub-dimensions of OCD (cleaning, controlling, and skepticism), depression, and guilt (Rachman, 1995). After the establishment of a link between TAF and OCD, Shafran et al. (1996a) developed a new and separate three-factor scale to measure TAF comprehensively. Thought-Action Fusion Scale (TAFS); consists of three factors, which are TAF-Likelihood-Self, TAF-Likelihood-Others, TAF-Morality. It was found that three-factor solutions accounted for over 66% of the variance (Shafran et al., 1996a). The TAF-Likelihood-Self subscale is related to the belief that one's thoughts can increase the likelihood of some adverse events that may happen to the person (e.g. item, if I think of myself falling ill, this increases the risk that I will fall ill.). The TAF-Likelihood-Others subscale covers the experiences related to the effect of one's thoughts on the likelihood of adverse events would happen to other people (e.g. item, if I think of a relative/friend losing their job, this increases the risk that they will lose their job). Finally, the experiences of having unethical thoughts equal to the carrying out these actions in thought content and the subsequent sense of moral responsibility for them are measured by the TAF-Morality subscale (e.g. item, when I think about making an obscene remark or gesture in church, it is almost as sinful as actually doing it.). Rassin et al. (2001b) further examined reliability and validity of TAFS in a sample of 285

undergraduate students. It was found that two (Likelihood and Morality) and three-factor (Likelihood-Self, Likelihood-Others, and Morality) solutions accounted for 49% and 56% of the variance, respectively. In terms of test-retest reliability, the correlations of the scores between 3 months were .52 for TAF-Total, .51 for TAF-Likelihood, .53 for TAF-Likelihood-Self, .47 for TAF-Likelihood-Other, .54 for TAF-Morality (Rassin et al., 2001b). In regards to validity, the correlation between TAF-Likelihood-Other scores and the participants' estimates of the probability of the adverse event written in the sentence completion task occurring in the next 24 hours was found to be .60 for high TAF sample (Rachman et al., 1996a).

Pointing out the omission of positive TAF experiences and harm avoidance via thoughts in the original scale, Amir et al. (2001) modified TAFS by adding subscales to assess the likelihood of events happening to others in terms of responsibility, cost, and valence of the thoughts and the likelihood that thoughts may have a role in averting harm from happening. In their two studies with undergraduates ($n = 424$ for the first study, $n = 298$ for the second study), the results revealed high OCD groups had significantly higher scores from both likelihood of positive TAF and the likelihood of harm prevention by thoughts subscales compared to low OCD groups. Thus, the authors asserted that TAF might represent a more general tendency to regard thought as having magical features (Amir et al., 2001). Recently, Meyer & Brown (2013), who reevaluated the psychometric properties of TAFS with a larger sample ($n = 700$), found that the two-factor version of TAFS, consisting of TAF-Probability and TAF-Morality, has better psychometric properties in the clinical outpatient sample. Moreover, TAF-Total had a higher significant correlation with OCD scores than depression and worry scores, supporting its convergent validity. Finally, Bailey et al. (2014) evaluated the factor structure of TAFS in a sample of 149 anxiety patients and 548 students. The results indicated that the original three-factor solution provides a good fit in both samples.

These research findings reported here consistently point towards that TAFS is a valid and acceptably reliable measure of TAF beliefs.

Thought-Action Fusion and Psychopathologies

OCD

Much of the literature on TAF since the 1990s has predominantly focused its role in the formation and maintenance of OCD symptoms. The first findings connecting TAF and OCD, except for case reports and clinical observations, came from the studies of Shafran et al. (1996a). In their first study with high OCD people ($n = 147$) and students ($n = 190$), the high OCD group had significantly higher TAF-Morality and TAF-Likelihood-Other scores than students, but not higher TAF-Likelihood-Self scores. In their second study comparing high OCD people ($n = 118$), adults ($n = 122$), and students ($n = 272$), it was found that there were significant differences of TAF-Morality scores between the high OCD and adult groups, and between adult and students groups, but not between high OCD and student groups. In terms of TAF-Likelihood-Other, all groups differed significantly from each other. For TAF-Likelihood-Self, similar to TAF-Morality, there were no significant differences between high OCD and student sample, while both groups had higher scores than the adult group. Moreover, they found significant small to medium correlations between TAF scales and OCD symptoms and depression for both high OCD and student groups. After controlling depression, all associations between TAF subscales and OCD symptoms retained their significance in the student sample. However, for the high OCD group, the only significant association remaining was between TAF-Likelihood-Other and OCD symptom checking.

After the development of TAFS, many other studies consistently reported similar findings between TAFS subscales and various OCD measures both in clinical and non-clinical samples.

(Altin & Gençöz, 2011; Amir et al., 2001; Lee et al., 2005; Rassin et al., 2000b; Rassin et al., 2001b; Reuman et al., 2017; Shafran et al., 1996a; Smári & Hólmsteinsson, 2001; Yorulmaz et al., 2004; Yorulmaz et al., 2008). Several studies indicated that the TAF-Likelihood subscale was more reliably and consistently related to OCD pathology than TAF-Morality (Berle & Starcevic, 2005; Shafran & Rachman, 2004). In their study with 622 Chinese undergraduate and postgraduate students, Zhu et al. (2017) found that TAF-Likelihood, but no TAF-Morality, mediated the relationship between inflated responsibility and OCD symptoms, supporting the TAF-Likelihood and OCD relationship also in Chinese culture. However, Yorulmaz et al. (2004) found higher correlations between TAF-Morality and OCD symptoms (compared to TAF-Likelihood) in the Turkish sample (n = 251). The authors interpreted that the difference may be due to the overrepresentation of religious obsessions in populations of Middle Eastern cultures. Bailey et al. (2014) also reported similar findings regarding the stronger correlations between TAF-Morality and OCD symptoms. It must also be stressed that several other studies reported that after controlling for depression (Jónsson et al., 2011) or depression and inflated responsibility (O'Leary et al., 2009), TAF was not significantly related to OCD.

TAF, Sense of Responsibility, Guilt, and Thought Suppression

It has been asserted that TAF is related to several distinct OCD features such as the sense of responsibility, guilt feelings, thought suppression (Berle & Starcevic, 2005; Shafran & Rachman, 2004). According to cognitive models of OCD (Rachman 1998, Salkovskis, 1985), the appraisals equating the thought of an action with realizing the action brings a inflated responsibility for hypothetical harm that the person caused or could have prevented. In addition, over-importance assigned to thoughts further enhances the sense of responsibility (Rachman, 1993). If a person has immoral thoughts and attaches importance to these thoughts, the person also feels morally

responsible for being the owner of these immoral thoughts. Unsurprisingly, these appraisals may evoke anxiety and guilt feelings, frequently seen in OCD patients (Rachman, 1993; Shafran et al., 1996b; Stewart & Shapiro, 2011). In this sense, it is the interpretation of the person that transforms usual intrusive thought into obsessional thought. Finally, TAF may exacerbate thought suppression attempts, which can be utilized to deal with inflated responsibility and guilt feelings. Thought suppression has been shown to lead to a rebound of suppressed material and worsen OCD symptomology (Purdon, 2004; Rassin et al., 2000a; Rassin et al., 2000b; Magee et al., 2012).

Several lines of studies reported medium to strong correlations between TAF-Total and responsibility (Gwilliam et al., 2004; Smari & Holmsteinsson, 2001; Yorulmaz et al., 2004; 2008); small to medium correlations between TAF-Likelihood and responsibility (Altın & Gençöz, 2011; O'Leary et al., 2011; Rachman et al., 1996, Yorulmaz et al., 2004, 2008); medium to strong correlations between TAF-Morality and responsibility (Altın & Gençöz, 2011; O'Leary et al., 2011; Yorulmaz et al., 2004; 2008). Contrary to the mentioned studies, Marino et al. (2008) reported no significant correlations between TAF-Likelihood and responsibility and small correlations between TAF-Morality and responsibility. Overall, the evidence supports that responsibility is associated with TAF-Morality, TAF-Likelihood, and TAF-Total. One study examining the effects of TAF psychoeducation interventions on inflated responsibility scores in the non-clinical population failed to find significant differences between pre-post high-responsibility thoughts (Marino-Carper, Negy, Burns, & Lunt, 2010). Further research is required to identify the causal relationship between TAF and sense of responsibility and whether decreasing TAF beliefs in return decrease inflated responsibility.

In one of the earliest studies in this field, Rachman et al. (1995) found a medium correlation between TAF subscale of the Responsibility Appraisal Questionnaire and state-trait guilt after

controlling for depression. However, Rachman et al. (1996) also showed that there were no significant correlations between TAF subscales and guilt. Yorulmaz et al. (2004) reported small significant correlations between guilt and TAF-Total ($r = .13$) and TAF-Morality ($r = .16$). Unfortunately, no further studies included guilt measures and mentioned TAF-guilt correlations. Thus, future studies may investigate TAF-guilt relationship and the mediator role of IR on the relationship between TAF and guilt.

In terms of thought suppression, the studies either reported no correlations (Rassin et al., 2001a); small correlations (Altın & Gençöz, 2011; Rassin et al., 2000b; Smari & Holmsteinsson, 2001) or medium correlations between TAF scales and thought suppression (Yorulmaz et al., 2008). In his experimental study, Rassin (2001) found that thought suppression failed to increase the number of intrusions and anxiety after TAF induction, even concluded that thought suppression was successful in reducing stress induced by the TAF intrusions. On the other hand, in their studies, Altın and Gençöz (2011), and Rassin et al. (2000b) showed that the relationship between TAF and OCD is mediated by thought suppression. Together, these studies indicate that TAF is consistently related to inflated responsibility and thought suppression, but more research is needed to understand the nature of the complex relationship between TAF and OCD features.

Other Psychopathologies

Despite being predominantly associated with OCD, previous research has revealed that TAFS subscales are related to other psychopathologies like other anxiety disorders (Abramowitz et al., 2003; Hazlett-Stevens et al., 2002; Hezel et al., 2019; Thompson-Hollands et al., 2013), depression (Abramowitz et al., 2003; Muris et al., 2001), schizotypy (Einstein & Menzies, 2004a, 2004b; Lee et al., 2005), schizophrenia (Kabakcı et al., 2008), and eating disorders (Shafran et al., 1999; Shafran & Robinson, 2004; Lee et al., 2020). Even in one of the first TAF studies, there was

evidence that all TAF scales were related to OCD symptoms and depression not only for the high OCD group both also for the student group (Shafran et al., 1996a).

Other Anxiety Disorders

Comparing 24 OCD and 20 non-OCD anxiety disorder patients, Rassin et al. (2001a) found that there was no significant difference between TAF scores of the two groups. Coles et al. (2001) conducted a study with 173 undergraduate students to examine the relationship between TAF and worry. The results revealed the TAF scales were significantly related to OCD features after controlling worry, while they were not related to worry after controlling OCD features. The results suggest that TAF and worry are related but are still distinct constructs (Coles et al., 2001). Investigating TAF in the generalized anxiety disorder relationship of a sample of 494 psychology students, Hazlett-Stevens et al. (2002) reported that TAF-Likelihood scores were positively correlated with pathological worry, however, and that they were not able to predict generalized anxiety disorder after controlling pathological worry. In their study (n = 96) comparing OCD with other anxiety disorders and depression, Abramowitz et al. (2003) found that there were no significant differences in TAF-Morality scores of the groups. In terms of TAF-Likelihood-Other scores, the OCD group significantly differed only from non-patients, social phobia, and depression groups. In terms of TAF-Likelihood-Self, the only significantly different groups from the OCD group were the social phobia group and non-patients. Furthermore, there were positive small to medium correlations between the TAF subscales scores and depression and anxiety scores. In their study comparing OCD patients (n = 20), other anxiety disorders (n = 21), and non-clinical controls (n = 22), O'Leary et al. (2009) found no significant differences between TAF scores of the OCD and other anxiety groups which were still higher than the control group. Bailey et al. (2014) compared OCD patients (n = 65), non-OCD anxiety disorder patients (n = 84), and students (n =

542) in terms of TAF scores. It was found that there were no significant differences for TAF-Likelihood-Other and Self between groups. The only significant difference was for TAF-Morality, OCD, and other anxiety group having higher TAF-Morality scores than students. However, there was no significant difference between TAF-Morality scores of OCD and other anxiety groups. Furthermore, all TAF scales were significantly associated (small to medium correlations) with OCD symptoms in the student sample. Similarly, Thompson-Hollands et al. (2013) compared people with generalized anxiety disorder ($n = 9$), OCD ($n = 8$), social anxiety disorder ($n = 8$), and panic disorder-agoraphobia ($n = 8$), in terms of TAF. Neither TAF-Mortality nor TAF-Likelihood scores were significantly different between the groups. Furthermore, generalized anxiety disorder was the strongest significant predictor of TAF-Likelihood. Finally, Hezel et al. (2019) found that self-reported TAF scores of OCD ($n = 41$) and social anxiety disorder ($n = 24$) patients were significantly higher than non-anxious controls ($n = 42$), but there was no significant difference between OCD and social anxiety disorder groups. Similar results were also reported (2003) in children (ages 7-13) and adolescent samples (ages 13-16) (Barrett & Healy, 2003; Muris et al., 2001). Rather than being specific only to OCD, several lines of evidence have suggested that TAF may be related to anxiety disorders, other than OCD, or be a general feature of anxiety disorders.

Depression

In the first study comparing major depression disorder (MDD) to OCD, Abramowitz et al. (2003) reported no difference in TAF-Morality and TAF-Likelihood-Self scores between MDD ($n = 19$) and OCD groups ($n = 20$). There were also significant correlations between TAF-Likelihood-Other ($r = .26$), TAF-Likelihood-Self ($r = .29$), and TAF-Morality ($r = .41$), and depression. Kivi et al. (2012) found that MDD ($n = 50$) and OCD ($n = 50$) patients had significantly higher TAF-Morality and TAF-Likelihood scores than normal controls ($n = 50$), but there was no significant

difference between the two groups. Similar results were also reported by Kivi et al. (2013). Overall, there seems to be some evidence to indicate that TAF is also an apparent construct in depression.

Schizotypy and Schizophrenia

Most of the studies investigating the relationship between TAF and schizotypy included magical ideation, a feature of schizotypy referring to the tendency to form abnormal causal relationships and belief in thought transmission, astrology, good luck charms, psychic energy, etc.. The first two studies ($n = 77$ and $n = 64$, respectively) examining TAF-schizotypy relationship were conducted by Muris and Merckelbach (2003). The results revealed that TAF was not significantly related to schizotypal features (magical ideation and perceptual aberration) after controlling fantasy proneness, which is briefly defined as “a unique constellation of personality traits and experiences that coalesced around a deep, profound, and long-standing involvement in fantasy and imagination” (Lynn & Rhue, 1988). Moreover, TAF was significantly related to fantasy proneness ($r = .43$ for the first sample and $r = .31$ for the second sample). Similar but more modest results about the association between TAF and fantasy proneness were also reported by Rassin et al. (2001b). To investigate the relationship between magical ideation and TAF, Einstein and Menzies (2004a) conducted two studies, one with 86 undergraduate students and another with 60 OCD patients. In the first study, it was found that there were significant medium correlations between TAF-Likelihood subscales and magical ideation ($r = .35$ for self and $r = .38$ for others). Magical ideation was the most strongly related variable to OCD symptoms, and none of the other variables were significantly related to OCD symptoms when magical ideation was controlled. In the second study with OCD patients, all correlations between magical ideation and TAF scales were significant and even higher than those found in the student sample ($r = .54$ for self, $r = .51$ for others, $r = .42$ for moral). In a non-clinical sample of 969 undergraduate students, Lee et al.

(2005) found that schizotypal-magical thinking was a significant predictor of TAF-Likelihood after controlling for OCD symptoms, anxiety, and depression. Comparing schizophrenia patients ($n = 45$) with the non-patient controls ($n = 41$), Kabakcı et al. (2008) revealed that only TAF-Likelihood-Others scores of the patients were significantly higher than non-patients even after controlling for obsessive-compulsive features, depressive symptoms, magical ideation, and schizotypy. In their study with 137 undergraduate participants, Rees et al. (2010) found that both TAF ($r = .37$) and magical ideation ($r = .52$) were significantly associated with obsessive-compulsive symptomatology. Furthermore, it was revealed that the negative affect partially mediated the relationship between magical ideation and TAF with OCD symptoms. Finally, in their study with 276 undergraduate students, Yorulmaz et al. (2011) found a small significant correlation between magical beliefs (precognition, psi-belief, superstition, etc.) and TAF-Likelihood ($r = .28$). The current evidence suggests that TAF could also be related to schizotypy, and the TAF-schizotypy relationship may be better explained by magical ideation or fantasy proneness.

Eating Disorders

Modifying TAF according to their clinical experiences, Shafran et al. (1999) asserted a novel concept called “thought-shape fusion” that may play a role in eating disorders. To examine the role of TAF related experiences in EDs, they developed Thought-Shape Fusion Scale (TSFS). TSFS consists of three factors. The first component, likelihood TSF, refers to the experiences such as thoughts of eating food being regarded as equal to eating that food (e.g. item, “just picturing myself gaining weight can really make me gain weight”). The second component, moral TSF, captures the belief that thoughts of eating food are morally equivalent to eating that food (e.g. item, “for me, just thinking about not exercising for a month is almost as wrong as actually not

exercising”). The third and final component, feelings TSF, represents appraisals that the thoughts of food make a person feel fatter (e.g. item, “I feel fatter if I just think about pigging out”) (Shafran et al., 1999). In a sample of 119 undergraduate students, Shafran et al. (1999) reported that there were large positive correlations between TSF and Eating Disorders Examination Questionnaire subscales (the restraint subscale, the eating concerns subscale, the weight concerns subscale, and the shape concerns subscale), ranging from .51 to .61. Revising previous TSFS, Shafran and Robinson (2004) compared 42 women with ED and 42 age-matched women in terms of TSF. It was found TSF scores of the ED group were significantly higher than the TSF scores of the age-match controls. Moreover, there were positive medium correlations between TSF, Eating Disorder Examination Questionnaire, and its subscales after controlling for depression. Similarly, Coelho et al. (2012) compared women with an ED ($n = 33$), women with OCD ($n = 24$), and control women without an ED or OCD ($n = 26$) by inducing TSF. The results showed that the ED group was more susceptible to TFS than the OCD and control group. Moreover, they had higher TFS scores, negative affects, and more neutralization behavior. Finally, in their study with 112 adolescent ($n = 63$) and adult female ($n = 49$) patients (anorexia nervosa $n = 57$, bulimia nervosa $n = 20$, and ED not otherwise specified $n = 35$) at a residential ED treatment center, Lee et al. (2020) examined the patients’ ED and OCD severity, as well as TAF scores at pre-post treatment. The results revealed that the TAF scores of the patients were significantly correlated with pre-treatment ED severity ($r = .25$ for self, $r = .23$ for others, $r = .20$ for moral). Higher pre-treatment TAF-Likelihood-Self significantly predicted higher ED severity at post-treatment, meaning that higher pre-treatment TAF-Likelihood-Self predicted poor treatment outcome. Furthermore, decreases in TAF-Likelihood-Self at post-treatment significantly predicted a reduction in ED severity after controlling for changes in OCD symptoms. The results suggest that targeting TAF

may further enhance treatment outcomes in EDs (Lee et al., 2020). The studies presented thus far provide evidence that compared to the TAF-anxiety disorders relationships, TFS could be specific to eating pathology, and TAF may also be prevalent in EDs.

Experimental Induction of TAF

Sentence Completion Task

The researchers developed several paradigms to induce TAF in experimental settings. In a study with high TAF 63 students, Rachman et al. (1996) attempted to evoke TAF in laboratory settings by asking participants to write the sentence, “I hope ----- is in a car accident.” on paper and fill it with a name of a friend or relative. Moreover, they were instructed to close their eyes and think about the event for some time. Later, the participants were asked to answer verbal analogue scale questions regarding anxiety, guilt, the likelihood estimation of the event occurring in the next 24 hours, the sense of control over the event, responsibility, moral wrongness, and urge to neutralize. After the manipulation, all participants reported significantly higher anxiety and an urge to neutralize (activities to prevent obsessions) compared to their pre-manipulation scores. While there were significant associations between TAF-Likelihood-Other scores and anxiety ($r = .26$), estimates of control ($r = .32$), and sense of responsibility ($r = .38$); TAF-Likelihood-Other was not significantly correlated with moral wrongness, guilt, and urge to neutralize. Interestingly, TAF-Morality scores were not also significantly correlated with any of the variables (Rachman et al., 1996).

Several other studies utilized the sentence completing task (SCT) to examine neutralization behaviors after TAF induction. In his study with 40 undergraduate students, Rassin (2001) induced TAF by accident sentence and then assigned participants to suppression ($n = 21$) and non-suppression conditions ($n = 19$). The participants in the suppression condition were asked to

suppress as soon as they detect any thought of accident, while non-suppressers were asked to set their thoughts free. Contrary to predictions, the results revealed that TS did not increase the number of intrusions, anxiety, moral wrongness, responsibility, guilt, and the likelihood estimations of the accident. In their study with 79 university students and employees, van den Hout et al. (2001) found that manipulation led to higher anxiety and an urge to neutralize; however, there were no significant associations between the strength of TAF induction and self-report TAF scores. van den Hout et al. (2002) and Bocci and Gordon, (2007) also replicated the effects of TAF induction on anxiety levels. To evaluate the validity of SCT-TAF induction, Berman et al. (2011a) conducted a study with 92 undergraduate students. The participants were asked to note two sentences (“I hope I have sex with....” and “I hope....is in a car accident today.”) on a card by filling the blank areas with the names of close relatives. They were also asked to contemplate on the events with their eyes closed. Then, they received several 0-100 VAS measuring their anxiety level, the perceived likelihood of the written events, and the moral wrongness of their thoughts. Furthermore, the participants received a prompt (“You may now do anything you wish to reduce or cancel the effects of writing or thinking about the sentence.”), and their responses were recorded to measure their engagement in neutralizing behavior. It was found that TAF-Likelihood-Other, but not TAF-Morality, was significantly correlated with the anxiety ($r = .37$) and likelihood ($r = .26$) measures of the car accident sentence. In terms of the incest sentence, TAF-Morality was significantly associated with anxiety ($r = .23$), perceived moral wrongness ($r = .26$), and neutralizing behavior ($r = .25$), while TAF-Likelihood-Other was significantly correlated only with anxiety ($r = .33$). The authors concluded that the findings support the convergent validity of SCT (Berman et al., 2011a). In their other study with 107 undergraduate students, Berman et al. (2011b) revealed that the participants report higher distress, urges to neutralize, and use of mental neutralizing behaviors

when they completed the sentences with the name of a relative, compared to completing the sentences with the name of a stranger.

Word Apple-Electric Shock Manipulation

In their study to examine TAF's role in the development of intrusions, Rassin et al. (1999) developed another interesting experimental manipulation paradigm. The participants in the experimental group ($n = 19$) were told that if the word "apple" pop-ups in their mind, an EEG cap will detect it, and a mild electrical shock will be administrated to a person in another room. The control group ($n = 26$) were only told that EEG would read their thoughts. It was found that the participants in the experimental group reported a higher frequency of targeted thought, distress, effort to avoid thinking, and internally directed anger. The authors, therefore, concluded that TAF may play a role in the transformation of normal intrusions into obsessive intrusions (Rassin et al., 1999). It seems that this manipulation induces MT rather than TAF. Because the participants think about an unrelated word instead of directly thinking about shocking other people, and the cause (thought) instantly leads to the effect (electric shock). The word "apple" functions like a magical word, abracadabra. On the other hand, TAF is more about the likelihood estimations and equating thoughts with actions. The authors defended their use of the neutral word by two arguments. The first one is that thoughts about electrical shocks could be experienced as stressful and unpleasant, and therefore, may override the effect of TAF. Secondly, the participants might have perceived thoughts about electrical shocks as unethical. (Rassin et al., 1999).

Interventions for TAF

Several studies investigated the effect of interventions on TAF and reported promising outcomes. In their treatment study with OCD ($n = 24$) and other anxiety disorder patients ($n = 20$), Rassin et al. (2001) showed that cognitive-behavioral therapy ($M_{treatment\ duration} = 5.9$ months, $SD =$

2.1 months, *range* = 2-10 months) significantly decreased TAF and thought suppression scores of the participants. However, pre-treatment TAF and thought suppression scores were not correlated with changes in OCD symptoms and general symptomology. In a study with 72 non-clinical participants, Zucker et al. (2002) first induced TAF via SCT. Then the participants received either an informational message about intrusive thoughts and TAF or a placebo message about stress. It was found that the participants in the psychoeducation group ($n = 36$) had significantly less anxiety and a lesser urge to neutralize post-treatment compared to the participants in the placebo group ($n = 36$).

More recently, Marino-Carper et al. (2010) conducted a psychoeducation intervention study utilizing Zucker et al.'s (2002) intervention messages and SCT. The participants received either psychoeducation regarding intrusive thoughts and TAF ($n = 41$), psychoeducation on thoughts and cognitions ($n = 47$) or psychoeducation about stress ($n = 51$). It was found that TAF-Morality scores of the TAF group were significantly lower than the scores of the control groups. However, the effect of psychoeducation regarding TAF was not preserved at a two-week follow-up. In terms of TAF-Likelihood, no differences were found between the groups at post-intervention. At the two-week follow-up assessment, the TAF-Likelihood scores of the manipulation group were significantly lower than the scores of the control group. Furthermore, the intervention group was the only group whose thought suppression scores did not increase significantly in the follow-up. Besiroglu et al. (2011) reported that 16 weeks of SSRI treatment significantly decreased TAF-Total and Morality scores of 67 OCD patients. The author suggested that the effect of the treatment can be explained by SSRI induced improvements in emotion processing (Besiroglu et al., 2011).

In their transdiagnostic CBT treatment (17-18 weeks in length) study with 33 patients, Thompson-Hollands et al. (2013) found that the patients' TAF-Likelihood scores significantly decreased independent of a general anxiety disorder diagnosis. There was no significant change of TAF-Morality scores between pre-post treatment. Similarly, Demirsöz et al. (2018) also reported significantly decreased TAF-Likelihood scores, but not TAF-Morality scores, after psychoeducation intervention regarding TAF. Siwiec et al. (2017) conducted a study (n = 67) to investigate the effects of single-session computerized cognitive bias modification for interpretations (CBM-I) on TAF beliefs. The results revealed that the experimental group had significantly lower TAF-Morality scores than the control group. There were no significant differences between groups in terms of TAF-Likelihood scales. The authors proposed that TAF-Likelihood may be more difficult to change by a brief single-session cognitive intervention (Siwiec et al., 2017). Jiménez-Ros, et al. (2020) investigated the effects of two false scientific abstracts on obsessive beliefs and aggressive impulse of 85 community participants. The participants in the experimental group (n = 41) read an abstract about the possibility and desirability of thought control, while the participants in the control group read an abstract about and addictive potential of Facebook. To induce TAF, the participants were asked to imagine stabbing a loved person. The results indicated only that post-manipulation TAF-Moral scores of both experimental and control groups were significantly lower than pre-manipulation TAF-Moral scores. Still, the effect size for the experimental group was larger than the control group's effect size. Finally, Lee, et al. (2020) showed TAF-Likelihood-Self and TAF-Morality scores of eating disorder (ED) patients reduced after receiving transtheoretical ED treatment not directly targeting TAF. These studies suggest that TAF may respond to therapeutic interventions, even to those not directly aiming it, such as transdiagnostic CBT or transtheoretical ED treatment.

EEG and Neural Correlates of TAF

The brain mechanism of TAF has been the subject of several recent papers. In their EEG study, Jones and Bhattacharya (2014) compared brain activities of 23 high OCD and 23 low OCD patients after TAF induction by SCT (e.g. I hope ... is in a car accident in the next 24 hours.). For high OCD patients, there was a greater upper beta frequency in precuneus. In previous studies, precuneus region has been found to be related to self-referential processing (Cavanna & Trimble, 2006), causal inferences (Fugelsang & Dunbar, 2005; Satpute et al., 2005), and free decision making, which is driven by internal reasoning or emotions rather than empirical evidence (Bode et al. 2012; Pesaran et al. 2008). Abnormalities in this region were also found to be related to OCD, generalized anxiety disorder, and schizophrenia (Jones & Bhattacharya, 2014). Moreover, greater precuneus activity was correlated with self-report TAF-Likelihood scores ($r = .48$ for precuneus beta 2, $r = .44$ for precuneus beta 3). In their fMRI study with 32 healthy participants, Lee et al. (2019) asked the participants to read negative statements anticipating negative events for either a close (CP) or neutral person (NP). It was found that lingual gyrus (retrieval of visual imagery), caudate nucleus, precuneus (mentalization), and some regions of the frontal cortex (empathy) were activated in both conditions. Compared to the NP group, insula, and temporal gyrus activation were higher in the CP group. On the other hand, there was higher activation in mentalization related regions such as the medial prefrontal cortex and the dorsal anterior cingulate cortex in the NP group. These findings suggest that visual imagery, empathy, and mentalization may be processes underlying TAF (Lee et al., 2019). Finally, utilizing Rassin et al.'s paradigm (1999), Lee et al. (2020) conducted another fMRI study with 38 healthy participants. An interesting finding of this study was the activations in bilateral lingual gyri, fusiform gyri, and middle occipital cortices. The authors concluded that “visual images and associated guilty feelings to produce vivid imagination

by stimulating each other during TAF situations.” (p. 7). To summarize, the preliminary evidence from the studies indicated that brain areas related to visual imagery and mentalization may be activated in TAF experiences.

Discussion and Conclusion

Over 30 years, many studies have been conducted to investigate the different aspects of TAF, from assessing its specificity to OCD to inducing it in experimental settings. The current evidence shows that TAF’s self-report measure, TAFS, is a valid and partially reliable scale designed to capture TAF beliefs. Researchers have proposed different ways of inducing TAF in experimental settings. While some of the studies showed significant associations between experimentally-induced measures and TAFS (Berman et al., 2011a; Jones & Bhattacharya, 2014, van den Hout et al., 2002), several others failed to support such associations (Lee et al., 2019; Lee et al., 2020; Rassin et al. 1999; van den Hout, 2001). The most recent studies have investigated brain mechanisms underlying TAF, further increasing our knowledge regarding the neuroscience of TAF by revealing the role of mentalization, empathy, causal inferences, and visual processing in TAF responses. So far, there has been little agreement about whether TAF is a specific type of magical thinking or not. However, considering the presence of TAF-related experiences in native people, children, many other psychopathologies and positive TAF experiences, it could be asserted that there may be a higher mental factor allowing both magical thinking and TAF experiences (Amir et al., 2001; Einstein & Menzies, 2004a, 2004b; Lee et al., 2005; Rees et al., 2010).

Rachman (1998) regarded TAF as a significant factor exacerbating the sense of inflated responsibility frequently seen in OCD patients. If TAF is not specific to OCD, then the sense of inflated responsibility must be present in other anxiety disorders too. Studies undertaken thus far provide conflicting evidence for the specificity of inflated responsibility to OCD (O’Leary et al.,

2009; Tolin et al., 2006). In their meta-analysis of fifty-eight studies investigating inflated responsibility in OCD, other anxiety disorders, and depression, Pozza and Dèttore (2014) found that inflated responsibility is equally associated with OCD and other anxiety disorders, questioning the specificity of inflated responsibility to OCD. According to current evidence, what distinguishes OCD from other anxiety disorders could not be the sense of inflated responsibility for the intrusion or TAF. Further studies are needed to explore the interaction between TAF and inflated responsibility and their relationship to OCD, as well as to other anxiety disorders. For example, it could be investigated whether reducing TAF leads to a decrease in the sense of inflated responsibility of both OCD and other anxiety disorder patients.

Cognitive models of OCD emphasize the importance of maladaptive beliefs and appraisals regarding threats, uncertainty, perfectionism, importance and control of thoughts, and inflated responsibility in OCD symptomology (Carr, 1974; Frost & Steketee, 1997; OCCWG, 1997; Rachman, 1993, 1998; Salkovskis, 1985). However, the previous studies have failed to demonstrate that these maladaptive beliefs and appraisals (except importance and control of thoughts) are specific to OCD, especially after controlling for anxiety or depression (Fergus & Wu, 2010; Hezel et al., 2019; Julien et al., 2007; Sassaroli et al., 2008; Tolin et al., 2006). It could be asserted that the same is true for TAF. As the scope of studies evolved from the investigation of TAF in OCD to its presence in other psychopathologies, the findings revealed that TAF may not be uniquely related to OCD. Some other and more general factors may have causal roles in the formation of TAF experiences. However, previous research has not covered these possible mechanisms.

According to cognitive theories, TAF is generally regarded as either a belief or an appraisal. Yet, it is not clear whether TAF is one of them or both (Berle & Starcevic, 2005). Reviewing the

current evidence, I argue that TAF may be an experience stemming from the mental simulation of anxiety-provoking events (Abed & de Pauw, 1998; Keen et al., 2008; Wheatley, 2000). Contrary to cognitive theories, it may be that mental simulation of adverse experiences produce TAF beliefs and appraisals. When an intrusion (in the form of thought, image, or impulse) pops-up in a person's mind, it seems that the mind of the person simulates the event and evokes a cognitive and affective experience that is similar to one that would be experienced in the event occurring in real-world settings. The person experiences possible thoughts and feelings as if the event truly happened. For example, if a person has an intrusion pertaining to killing a child, the simulated mental scene of killing the child may be enough to produce a sense of being an evil murderer that would be evoked if the person killed the child in real-world settings. The main difference of this hypothesis from the appraisal model is that the person does not equate thoughts of killing with actual killing and then interprets his or her thoughts as a sign of personal malignancy, but the person really experiences a sense of being a murderer as a result of mental simulation of the adverse event. The frequency and reoccurrence of the intrusions together with co-occurring simulated experiences would further strengthen the sense of being an immoral and evil person and TAF beliefs that are generally found in OCD patients.

It has been proposed that there could be a difference between TAF-Morality and TAF-Likelihood experiences (Berle & Starcevic, 2005). While the morality items of TAFS involve statements equating thoughts and actions, the likelihood items of TAFS comprise statements that thoughts have the power to influence the probability of things that may happen in the real world. Thus, TAF-Morality relying on the event's simulation may be a different experience than TAF-Likelihood, which includes magical thinking or the misattribution of the cause-effect relationship. That may be the reason that previous studies have either failed to find significant relationships

(Einstein & Menzies, 2004a; Rees et al., 2010) or reported lower or very low significant correlations between TAF-Morality and magical ideation compared to TAF-Likelihood and magical ideation (Lee et al., 2005; Einstein & Menzies, 2004b). It may also be possible that simulating adverse events produce a sense of having an impact on the external world due to realistic experience evoked by the simulation and promotes TAF-Likelihood beliefs. As a side effect of the simulation, the person may implicitly believe that he or she can have an impact on external reality, therefore, has a higher perceived likelihood of adverse events. To develop a full picture of TAF, additional studies will be needed that investigate phenomenological differences between morality and likelihood experiences beyond revealing their relationships with different psychopathological constructs.

According to the simulation hypothesis, it is expected that simulated experiences will be closer to real ones if the intrusions appear in the form of images rather than thoughts or impulses. Moreover, there could be a positive association between TAF experiences, imagery ability, and vividness of imagery. There are some preliminary findings to support this hypothesis. In their study with 37 OCD patients, Speckens et al. (2007) found that compared to the patients reporting no intrusive images ($n = 7$), the patients reporting intrusive images ($n = 30$) had more obsessive-compulsive symptoms, responsibility beliefs, and anxiety. Furthermore, the recent evidence suggests that mental imagery is able to produce powerful affective experiences similar to real-life equivalents by activating the visual cortex and related areas (Cui et al., 2007; Ganis et al., 2004; Hirsch & Holmes, 2007; Holmes & Mathews, 2005; Holmes et al., 2008; Ji et al., 2016; Mertens et al., 2020, O'Shea & Moran, 2019). Similarly, brain imaging studies of TAF suggested that visual processing may also take place in the formation of TAF responses (Lee et al., 2019; Lee et al., 2020). But it is not a surprise because TAF induction procedures generally involve instructions

regarding imagining the adverse events. Considerably more work will need to be done to determine whether spontaneous intrusive mental imagery of clinical participants functions similar to intentional intrusive mental imagery of non-clinical populations.

As pointed out by Berle and Starcevic (2005), the literature indicates that even non-clinical populations endorse TAF beliefs to a degree lower than OCD or other anxiety disorder patients did. So it seems that high-level cognitive ability of mental imagery may allow everyone to have TAF experiences. There are no studies directly investigating the relationship between TAF, imagery ability, and anxiety disorders, but Muris & Merckelbach's preliminary findings (2003) may also suggest a link between TAF and imagery ability since fantasy proneness and imagery are strongly related constructs. So Why do people with anxiety disorders endorse TAF beliefs more than non-clinical people? Do people with anxiety disorders have better imagery ability than non-clinical people? Could there be a relationship between TAF beliefs and the frequency of intrusive mental imagery? More research is needed to answer the questions and clarify the role of visual processing and imagery in TAF, OCD, and other anxiety disorders.

While the presence of TAF in many other psychopathologies makes it a more valuable construct, it simultaneously requires further well-designed studies to investigate the complex relationship between TAF, other related constructs, and disorders. More information on TAF would help us establish a greater degree of accuracy on this matter. It seems that studying and understanding TAF would bring benefits and better treatment options not only for OCD but also for all psychopathologies.

References

- Abed, R. T., & de Pauw, K. W. (1998). An evolutionary hypothesis for obsessive compulsive disorder: a psychological immune system?. *Behavioural neurology*, 11(4), 245-250.
- Abramowitz, J. S., Whiteside, S., Lynam, D., & Kalsy, S. (2003). Is thought–action fusion specific to obsessive–compulsive disorder?: A mediating role of negative affect. *Behaviour Research and Therapy*, 41(9), 1069-1079.
- Altin, M., & Gençöz, T. (2011). How does thought-action fusion relate to responsibility attitudes and thought suppression to aggravate the obsessive-compulsive symptoms?. *Behavioural and Cognitive psychotherapy*, 39(1), 99.
- Amir, N., Freshman, M., Ramsey, B., Neary, E., & Brigidi, B. (2001). Thought–action fusion in individuals with OCD symptoms. *Behaviour research and therapy*, 39(7), 765-776.
- Bailey, B. E., Wu, K. D., Valentiner, D. P., & McGrath, P. B. (2014). Thought–action fusion: Structure and specificity to OCD. *Journal of Obsessive-Compulsive and Related Disorders*, 3(1), 39-45.
- Barrett, P. M., & Healy, L. J. (2003). An examination of the cognitive processes involved in childhood obsessive–compulsive disorder. *Behaviour Research and Therapy*, 41(3), 285-299.
- Berle, D., & Starcevic, V. (2005). Thought–action fusion: Review of the literature and future directions. *Clinical psychology review*, 25(3), 263-284.
- Berman, N. C., Abramowitz, J. S., Wheaton, M. G., Pardue, C., & Fabricant, L. (2011a). Evaluation of an in vivo measure of thought–action fusion. *Journal of Cognitive Psychotherapy*, 25(2), 155-164.
- Berman, N. C., Wheaton, M. G., Fabricant, L. E., Jacobson, S. R., & Abramowitz, J. S. (2011b). The effects of familiarity on thought–action fusion. *Behaviour research and therapy*, 49(10), 695-699.
- Besiroglu, L., Çetinkaya, N., Selvi, Y., & Atli, A. (2011). Effects of selective serotonin reuptake inhibitors on thought-action fusion, metacognitions, and thought suppression in obsessive-compulsive disorder. *Comprehensive psychiatry*, 52(5), 556-561.
- Bocci, L., & Gordon, P. K. (2007). Does magical thinking produce neutralising behaviour? An experimental investigation. *Behaviour Research and Therapy*, 45(8), 1823-1833.

- Bode, S., Bogler, C., Soon, C. S., & Haynes, J. D. (2012). The neural encoding of guesses in the human brain. *Neuroimage*, 59(2), 1924-1931.
- Carr, A. T. (1974). Compulsive neurosis: A review of the literature. *Psychological Bulletin*, 81(5), 311–318. <https://doi.org/10.1037/h0036473>
- Cavanna, A. E., & Trimble, M. R. (2006). The precuneus: a review of its functional anatomy and behavioural correlates. *Brain*, 129(3), 564-583.
- Coelho, J. S., Baeyens, C., Purdon, C., Pitet, A., & Bouvard, M. (2012). Cognitive distortions and eating pathology: Specificity of thought–shape fusion. *Behaviour Research and Therapy*, 50(7-8), 449-456.
- Coles, M. E., Mennin, D. S., & Heimberg, R. G. (2001). Distinguishing obsessive features and worries: The role of thought–action fusion. *Behaviour Research and Therapy*, 39(8), 947-959.
- Cui, X., Jeter, C. B., Yang, D., Montague, P. R., & Eagleman, D. M. (2007). Vividness of mental imagery: individual variability can be measured objectively. *Vision research*, 47(4), 474-478.
- Einstein, D. A., & Menzies, R. G. (2004a). Role of magical thinking in obsessive–compulsive symptoms in an undergraduate sample. *Depression and Anxiety*, 19(3), 174-179.
- Einstein, D. A., & Menzies, R. G. (2004b). The presence of magical thinking in obsessive compulsive disorder. *Behaviour Research and Therapy*, 42(5), 539-549.
- Fergus, T. A., & Wu, K. D. (2010). Do symptoms of generalized anxiety and obsessive-compulsive disorder share cognitive processes?. *Cognitive Therapy and Research*, 34(2), 168-176.
- Fergus, T. A., & Rowatt, W. C. (2018). Examining associations between thought-action fusion and state mental contamination following an in vivo thought induction task. *Journal of obsessive-compulsive and related disorders*, 17, 16-22.
- Freud, S. (1894). The Neuro-Psychoses of Defense. *SE 3*, 41-61.
- Freud, S. (1900). The Interpretation of Dreams. *SE 4-5*.
- Freud, S. (1909). Notes upon a Case of Obsessional Neurosis. *SE 10*, 153-249.
- Freud, S. (1913). Totem and Taboo. *SE 10*, 1-161.

- Frost, R. O., & Steketee, G. (1997). Perfectionism in obsessive-compulsive disorder patients. *Behaviour research and therapy*, 35(4), 291-296.
- Fugelsang, J. A., & Dunbar, K. N. (2005). Brain-based mechanisms underlying complex causal thinking. *Neuropsychologia*, 43(8), 1204-1213.
- Ganis, G., Thompson, W. L., & Kosslyn, S. M. (2004). Brain areas underlying visual mental imagery and visual perception: an fMRI study. *Cognitive Brain Research*, 20(2), 226-241.
- Gjelsvik, B., Kappelmann, N., von Soest, T., Hinze, V., Baer, R., Hawton, K., & Crane, C. (2018). Thought–Action Fusion in Individuals with a History of Recurrent Depression and Suicidal Depression: Findings from a Community Sample. *Cognitive therapy and research*, 42(6), 782-793.
- Gwilliam, P., Wells, A., & Cartwright-Hatton, S. (2004). Dose meta-cognition or responsibility predict obsessive–compulsive symptoms: a test of the metacognitive model. *Clinical Psychology & Psychotherapy: An International Journal of Theory & Practice*, 11(2), 137-144.
- Hazlett-Stevens, H., Zucker, B. G., & Craske, M. G. (2002). The relationship of thought–action fusion to pathological worry and generalized anxiety disorder. *Behaviour Research and Therapy*, 40(10), 1199-1204.
- Hezel, D. M., Stewart, S. E., Riemann, B. C., & McNally, R. J. (2019). Clarifying the thought-action fusion bias in obsessive-compulsive disorder. *Journal of Obsessive-Compulsive and Related Disorders*, 20, 75-84.
- Hirsch, C. R., & Holmes, E. A. (2007). Mental imagery in anxiety disorders. *Psychiatry*, 6(4), 161-165.
- Holmes, E. A., & Mathews, A. (2005). Mental imagery and emotion: A special relationship?. *Emotion*, 5(4), 489.
- Holmes, E. A., Geddes, J. R., Colom, F., & Goodwin, G. M. (2008). Mental imagery as an emotional amplifier: Application to bipolar disorder. *Behaviour research and therapy*, 46(12), 1251-1258.
- Ji, J. L., Heyes, S. B., MacLeod, C., & Holmes, E. A. (2016). Emotional mental imagery as simulation of reality: Fear and beyond—A tribute to Peter Lang. *Behavior Therapy*, 47(5), 702-719.

- Jiménez-Ros, A., Faísca, L., Martins, T., Janeiro, L., & Martins, A. (2020). Experimental manipulation of beliefs about the importance of thoughts and the effect on an aggressive impulse. *Behavioural and Cognitive Psychotherapy*, 48(5), 626-630.
doi:10.1017/S1352465820000120
- Jones, R., & Bhattacharya, J. (2014). A role for the precuneus in thought–action fusion: Evidence from participants with significant obsessive–compulsive symptoms. *NeuroImage: Clinical*, 4, 112-121.
- Jónsson, H., Hougaard, E., & Bennedsen, B. E. (2011). Dysfunctional beliefs in group and individual cognitive behavioral therapy for obsessive compulsive disorder. *Journal of Anxiety Disorders*, 25(4), 483-489.
- Julien, D., O'Connor, K. P., & Aardema, F. (2007). Intrusive thoughts, obsessions, and appraisals in obsessive–compulsive disorder: A critical review. *Clinical Psychology Review*, 27(3), 366-383.
- Kabakcı, E., Demir, B., Demirel, H., & Şevik, A. E. (2008). Thought–action fusion: Is it present in schizophrenia?. *Behaviour Change*, 25(3).
- Keen, N., Brown, G. P., & Wheatley, J. (2008). Obsessive compulsive symptoms and the simulation of future negative events. *British Journal of Clinical Psychology*, 47(3), 265-279.
- Kivi, H. G., Rik, N. M., & Movahhed, F. S. (2013). Explanation of obsessive-compulsive disorder and major depressive disorder on the basis of thought-action fusion. *Iranian journal of psychiatry and behavioral sciences*, 7(2), 44.
- Kivi, H. G., Rik, N. M., & Niloofar, M. (2012). Comparison of thought–action fusion in peoples with obsessive–compulsive disorder and major depression disorder. *Int. J. Appl. Psychol*, 2, 77-82.
- Lee, E. B., Barney, J. L., Twohig, M. P., Lensegrav-Benson, T., & Quakenbush, B. (2020). Obsessive compulsive disorder and thought action fusion: Relationships with eating disorder outcomes. *Eating Behaviors*, 101386.
- Lee, H. J., Coughle, J. R., & Telch, M. J. (2005). Thought–action fusion and its relationship to schizotypy and OCD symptoms. *Behaviour Research and Therapy*, 43(1), 29-41.

- Lee, S. W., Cha, H., Chung, Y., Kim, E., Song, H., Chang, Y., & Lee, S. J. (2019). The neural correlates of thought–action fusion in healthy adults: A functional magnetic resonance imaging study. *Depression and anxiety*, 36(8), 732-743.
- Lee, S. W., Kim, E., Chung, Y., Cha, H., Song, H., Chang, Y., & Lee, S. J. (2020). Believing is seeing: an fMRI study of thought-action fusion in healthy male adults. *Brain Imaging and Behavior*, 1-11.
- Lévy-Bruhl, L. (2018). *Revival: How Natives Think (1926)*. Routledge. (Original work published in 1910)
- Lynn, S. J., & Rhue, J. W. (1988). Fantasy proneness: Hypnosis, developmental antecedents, and psychopathology. *American psychologist*, 43(1), 35.
- Magee, J. C., Harden, K. P., & Teachman, B. A. (2012). Psychopathology and thought suppression: A quantitative review. *Clinical psychology review*, 32(3), 189-201.
- Marino, T. L., Lunt, R. A., & Negy, C. (2008). Thought–action fusion: A comprehensive analysis using structural equation modeling. *Behaviour Research and Therapy*, 46(7), 845-853.
- Marino-Carper, T., Negy, C., Burns, G., & Lunt, R. A. (2010). The effects of psychoeducation on thought-action fusion, thought suppression, and responsibility. *Journal of Behavior Therapy and Experimental Psychiatry*, 41(3), 289-296.
- McFall, M. E., & Wollersheim, J. P. (1979). Obsessive-compulsive neurosis: A cognitive-behavioral formulation and approach to treatment. *Cognitive Therapy and Research*, 3(4), 333-348.
- Mertens, G., Kryptos, A. M., & Engelhard, I. M. (2020). A review on mental imagery in fear conditioning research 100 years since the ‘Little Albert’ study. *Behaviour Research and Therapy*, 126, 103556.
- Meyer, J. F., & Brown, T. A. (2013). Psychometric evaluation of the thought–action fusion scale in a large clinical sample. *Assessment*, 20(6), 764-775.
- Muris, P., & Merckelbach, H. (2003). Thought-action fusion and schizotypy in undergraduate students. *British Journal of Clinical Psychology*, 42(2), 211-216.
- Muris, P., Meesters, C., Rassin, E., Merckelbach, H., & Campbell, J. (2001). Thought–action fusion and anxiety disorders symptoms in normal adolescents. *Behaviour Research and Therapy*, 39(7), 843-852.

- Obsessive Compulsive Cognitions Working Group. (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy*, 35, 667–681.
- O’Leary, E. M., Rucklidge, J. J., & Blampied, N. (2009). Thought-action fusion and inflated responsibility beliefs in obsessive-compulsive disorder. *Clinical Psychologist*, 13(3), 94–101.
- O’Shea, H., & Moran, A. (2019). Revisiting Imagery in Psychopathology: Why Mechanisms Are Important. *Frontiers in psychiatry*, 10, 457.
- Piaget, J. P. (1929). *The child’s conception of the world*. London: Routledge & Kegan Paul.
- Pozza, A., & Dèttore, D. (2014). Are inflated responsibility beliefs specific to OCD? Meta-analysis of the relations of responsibility to OCD, anxiety disorders, and depression symptoms. *Clinical Neuropsychiatry: Journal of Treatment Evaluation*.
- Pesaran, B., Nelson, M. J., & Andersen, R. A. (2008). Free choice activates a decision circuit between frontal and parietal cortex. *Nature*, 453(7193), 406-409.
- Purdon, C. (2004). Empirical investigations of thought suppression in OCD. *Journal of Behavior Therapy and Experimental Psychiatry*, 35(2), 121-136.
- Rachman, S. (1973). Some similarities and differences between obsessional ruminations and morbid preoccupations. *Canadian Psychiatric Association Journal*, 18, 71-74.
- Rachman, S. (1993). Obsessions, responsibility and guilt. *Behaviour research and therapy*, 31(2), 149-154.
- Rachman, S. (1998). A cognitive theory of obsessions: Elaborations. *Behaviour research and therapy*, 36(4), 385-401.
- Rachman, S., Shafran, R., Mitchell, D., Trant, J., & Teachman, B. (1996). How to remain neutral: An experimental analysis of neutralization. *Behaviour Research and Therapy*, 34(11-12), 889-898.
- Rachman, S., Thordarson, D. S., Shafran, R., & Woody, S. R. (1995). Perceived responsibility: Structure and significance. *Behaviour Research and therapy*, 33(7), 779-784.
- Rassin, E. (2001). The contribution of thought–action fusion and thought suppression in the development of obsession-like intrusions in normal participants. *Behaviour Research and Therapy*, 39(9), 1023-1032.

- Rassin, E., Diepstraten, P., Merckelbach, H., & Muris, P. (2001a). Thought-action fusion and thought suppression in obsessive-compulsive disorder. *Behaviour Research and Therapy*, 39(7), 757-764.
- Rassin, E., Merckelbach, H., & Muris, P. (2000a). Paradoxical and less paradoxical effects of thought suppression: A critical review. *Clinical Psychology Review*, 20(8), 973-995.
- Rassin, E., Merckelbach, H., Muris, P., & Schmidt, H. (2001b). The thought-action fusion scale: Further evidence for its reliability and validity. *Behaviour Research and Therapy*, 39(5), 537-544.
- Rassin, E., Merckelbach, H., Muris, P., & Spaan, V. (1999). Thought-action fusion as a causal factor in the development of intrusions
- Rassin, E., Muris, P., Schmidt, H., & Merckelbach, H. (2000b). Relationships between thought-action fusion, thought suppression and obsessive-compulsive symptoms: A structural equation modeling approach. *Behaviour Research and Therapy*, 38(9), 889-897.
- Rees, C. S., Draper, M., & Davis, M. C. (2010). The relationship between magical thinking, thought-action fusion and obsessive-compulsive symptoms. *International Journal of Cognitive Therapy*, 3(3), 304-311.
- Reuman, L., Buchholz, J., Blakey, S., & Abramowitz, J. S. (2017). Uncertain and fused: cognitive fusion, thought-action fusion, and the intolerance of uncertainty as predictors of obsessive-compulsive symptom dimensions. *Journal of Cognitive Psychotherapy*, 31(3), 191-203.
- Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour research and therapy*, 23(5), 571-583.
- Salkovskis, P. M., Richards, H. C., & Forrester, E. (1995). The relationship between obsessional problems and intrusive thoughts. *Behavioural and Cognitive Psychotherapy*, 23(3), 281-299.
- Salkovskis, P., Shafran, R., Rachman, S., & Freeston, M. H. (1999). Multiple pathways to inflated responsibility beliefs in obsessional problems: Possible origins and implications for therapy and research. *Behaviour Research and Therapy*, 37(11), 1055-1072.
- Sassaroli, S., Lauro, L. J. R., Ruggiero, G. M., Mauri, M. C., Vinai, P., & Frost, R. (2008). Perfectionism in depression, obsessive-compulsive disorder and eating disorders. *Behaviour Research and Therapy*, 46(6), 757-765.

- Satpute, A. B., Fenker, D. B., Waldmann, M. R., Tabibnia, G., Holyoak, K. J., & Lieberman, M. D. (2005). An fMRI study of causal judgments. *European Journal of Neuroscience*, 22(5), 1233-1238.
- Shafran, R., & Rachman, S. (2004). Thought-action fusion: A review. *Journal of Behavior Therapy and Experimental Psychiatry*, 35(2), 87-107.
- Shafran, R., & Robinson, P. (2004). Thought-shape fusion in eating disorders. *British Journal of Clinical Psychology*, 43(4), 399-408.
- Shafran, R., Teachman, B. A., Kerry, S., & Rachman, S. (1999). A cognitive distortion associated with eating disorders: Thought-shape fusion. *British Journal of Clinical Psychology*, 38(2), 167-179.
- Shafran, R., Thordarson, D. S., & Rachman, S. (1996a). Thought-action fusion in obsessive compulsive disorder. *Journal of Anxiety Disorders*, 10(5), 379-391.
- Shafran, R., Watkins, E., & Charman, T. (1996b). Guilt in obsessive-compulsive disorder. *Journal of Anxiety Disorders*, 10(6), 509-516.
- Siwiec, S. G., Davine, T. P., Kresser, R. C., Rohde, M. M., & Lee, H. J. (2017). Modifying thought-action fusion via a single-session computerized interpretation training. *Journal of Obsessive-Compulsive and Related Disorders*, 12, 15-22.
- Smári, J., & Hólmsteinsson, H. E. (2001). Intrusive thoughts, responsibility attitudes, thought-action fusion, and chronic thought suppression in relation to obsessive-compulsive symptoms. *Behavioural and Cognitive Psychotherapy*, 29(1), 13.
- Speckens, A. E., Hackmann, A., Ehlers, A., & Cuthbert, B. (2007). Imagery special issue: Intrusive images and memories of earlier adverse events in patients with obsessive compulsive disorder. *Journal of Behavior Therapy and Experimental Psychiatry*, 38(4), 411-422.
- Stewart, S. E., & Shapiro, L. (2011). Pathological guilt: A persistent yet overlooked treatment factor in obsessive-compulsive disorder. *Annals of Clinical Psychiatry*, 23(1), 63-70.
- Suler, J. R. (1989). Mental imagery in psychoanalytic treatment. *Psychoanalytic Psychology*, 6(3), 343.
- Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Thought-action fusion across anxiety disorder diagnoses: Specificity and treatment effects. *The Journal of nervous and mental disease*, 201(5), 407.

- Tolin, D. F., Worhunsky, P., & Maltby, N. (2006). Are “obsessive” beliefs specific to OCD?: A comparison across anxiety disorders. *Behaviour Research and Therapy*, 44(4), 469-480.
- van den Hout, M., van Pol, M., & Peters, M. (2001). On becoming neutral: effects of experimental neutralizing reconsidered. *Behaviour Research and Therapy*, 39(12), 1439-1448.
- van den Hout, M., Kindt, M., Weiland, T., & Peters, M. (2002). Instructed neutralization, spontaneous neutralization and prevented neutralization after an obsession-like thought. *Journal of Behavior Therapy and Experimental Psychiatry*, 33(3-4), 177-189.
- Yorulmaz, O., Inozu, M., & Gültepe, B. (2011). The role of magical thinking in obsessive-compulsive disorder symptoms and cognitions in an analogue sample. *Journal of Behavior Therapy and Experimental Psychiatry*, 42(2), 198-203.
- Yorulmaz, O., Karanci, A. N., Bastug, B., Kisa, C., & Goka, E. (2008). Responsibility, thought-action fusion, and thought suppression in Turkish patients with obsessive-compulsive disorder. *Journal of Clinical Psychology*, 64(3), 308-317.
- Yorulmaz, O., Yılmaz, A. E., & Gençöz, T. (2004). Psychometric properties of the Thought-Action Fusion Scale in a Turkish sample. *Behaviour Research and Therapy*, 42(10), 1203-1214.
- Zhu, Y., Xu, W., Fu, Z., Yu, M., Xu, Q., Wang, J., & Chasson, G. S. (2017). Thought-action fusion mediates the relation between inflated responsibility and obsessive-compulsive symptoms in China: A cross-sectional structural equation model. *Journal of Obsessive-Compulsive and Related Disorders*, 12, 23-28.
- Zucker, B. G., Craske, M. G., Barrios, V., & Holguin, M. (2002). Thought action fusion: can it be corrected?. *Behaviour Research and Therapy*, 40(6), 653-664.