AUTOMATIC AVOIDANCE TENDENCY FROM CONTAMINATION-RELATED STIMULI

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AUTOMATIC AVOIDANCE TENDENCY FROM CONTAMINATION-RELATED STIMULI

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Emre Yıldırım

ABSTRACT

AUTOMATIC AVOIDANCE TENDENCY FROM CONTAMINATION-RELATED STIMULI

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In this study, we investigated how automatic (i.e. rapid, implicit, unintentional) the avoidance tendency from contamination-related stimuli is. We measured the automatic avoidance tendency with our modified version of the online-VAAST (Visual Approach/Avoidance by the Self Task), in which participants approach/avoid neutral and contamination-related stimuli with computer keys. In order to increase the level of automaticity which can be inferred, we used colored picture frames and asked participants to approach/avoid the pictures based on the frame colors. Thus, participants did not explicitly think about the picture contents, and the responses were executed rapidly. We also asked participants how disturbing they found the pictures which were used in the task, and we used a self-report questionnaire in order to assess participants' contamination-related obsessive-compulsive symptoms.

We had three main hypotheses. (1) As people’s contamination symptom scores increase, they find contamination pictures (but not neutral pictures) more disturbing. (2) More disturbing pictures induce automatic avoidance tendencies more strongly. Specifically, responses are slower for approaching more disturbing pictures, and faster for avoiding more disturbing pictures. (3) Contamination pictures induce automatic avoidance tendencies more strongly for people who have more contamination symptoms. Specifically, as contamination symptom scores increase, responses become slower for approaching contamination pictures compared to neutral pictures, and faster for avoiding contamination pictures compared to neutral pictures. We used linear mixed-effects modeling in our analyses. Only Hypothesis 1 was supported. In terms of Hypotheses 2 and 3, there were two consistent findings: First, disturbing/contamination pictures caused slower responses, and this picture effect was stronger (but not significantly) for the approach movement; second, as participants’ gaming scores increased, responses became faster; and the picture effect became weaker (but not significantly).

Keywords: Automatic avoidance tendency, contamination, online-VAAST, approach avoidance task

ÖZ

BULAŞMA/KİRLENME İLE ALAKALI UYARANLARDAN KAÇINMA EĞİLİMİ

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Bu çalışmada bulaşma/kirlenme ile alakalı uyaranlardan kaçınma eğiliminin ne kadar otomatik (hızlı, istemsiz, örtük) olduğunu inceledik. Otomatik kaçınma eğilimini ölçmek için online-VAAST (Visual Approach/Avoidance by the Self Task) adlı bir bilgisayar testini, üzerinde bazı değişiklikler yaparak kullandık. Bu testte, katılımcılar ekranda gördükleri resimlere bilgisayar tuşlarıyla yaklaşıp uzaklaştılar. Resimlerin yarısı bulaşma/kirlenme ile ilgili içeriklerden, diğer yarısı ise nötr içeriklerden oluşuyordu. Tüm resimler hem mavi hem sarı çerçeve renkleriyle gösterildi ve katılımcılardan çerçeve rengine göre hareket etmesi istendi ("maviyse yaklaşın, sarıysa uzaklaşın" gibi). Böylece katılımcıların resimlerin içeriklerine fazla odaklanmadan hızlı bir şekilde hareket etmesi amaçlandı. Testten sonra katılımcılara gördükleri resimleri ne kadar rahatsız edici bulduklarını sorduk ve bir envanter aracılığıyla bulaşma/kirlenme ile alakalı obsesif-kompulsif semptomlarını ölçtük.

Çalışmaya başlarken üç temel hipotezimiz vardı. (1) İnsanların bulaşma/kirlenme semptomları arttıkça bulaşma/kirlenme ile ilgili resimlerden (ama nötr resimlerden değil) daha fazla rahatsız olurlar. (2) Daha rahatsız edici resimler daha güçlü otomatik kaçınma eğilimleri yaratır: daha rahatsız edici resimlere yaklaşmak daha uzun zaman alırken bu resimlerden uzaklaşmak daha kısa zaman alır. (3) Bulaşma/kirlenme ile ilgili resimler bulaşma/kirlenme semptomları daha fazla olan insanlar için daha güçlü otomatik kaçınma eğilimleri yaratır: insanların bulaşma/kirlenme semptomları arttıkça, bulaşma/kirlenme ile ilgili resimlere yaklaşmak daha uzun zaman alırken bu resimlerden uzaklaşmak daha kısa zaman alır (nötr resimlere göre). İstatistiksel analizlerimizde lineer karma modelleme kullandık. Analizler sonucunda sadece birinci hipotez desteklendi. İkinci ve üçüncü hipotezlerle ilgili analizlerde istikrarlı olarak iki bulguya rastlandı. Birincisi, rahatsız edici (bulaşma/kirlenme ile ilgili) resimler testteki tepki sürelerini artırdı ve bu etki özellikle resimlere yaklaşırken güçlendi (ama istatiksel olarak anlamlı bir şekilde değil). İkincisi, katılımcıların geçmiş oyun deneyimlerinin fazla olması testteki tepki sürelerini azalttı ve resimlerin tepki süresi üzerindeki etkisini azalttı (ama istatiksel olarak anlamlı bir şekilde değil).

Anahtar kelimeler: Kaçınma eğilimi, bulaşma/kirlenme, online-VAAST

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CHAPTER 1

INTRODUCTION

1.1. Approach-Avoidance Tendencies

Approach and avoidance are two fundamental action patterns for organisms: A single cell approaches some chemicals, a cockroach avoids the light, a tree approaches water with its root, a bird avoids a scarecrow… Organisms are inclined to approach and avoid certain things, while what those things are and how they are approached/avoided vary a lot. For humans, approached-avoided stimuli may be concrete objects/situations or abstract representations of them (Elliot, Eder, & Harmon-Jones, 2013), and approach-avoidance responses may be physical or mental acts (see "overt and covert behaviors" in Spiegler & Guevremont, 2010). For instance, a mother with obsessions of harming her child (avoided stimulus) may hold her child only when there is someone else in the room (avoidance response) or hold her child while praying in her mind (avoidance response).

It is obvious that the approached-avoided stimulus precedes the approach/ avoidance response. Less obvious is what happens in the organism between the approached/avoided stimulus and approach/avoidance response. Logically, the stimulus must first be evaluated (Elliot & Covington, 2001). Evaluation is mainly based on the affective valence (positive vs. negative) of the stimulus (Elliot, 2006), but there may also be additional evaluative processes such as a primary threat-detection system (March, Gaertner, & Olson, 2018). In any case, evaluation of stimuli can occur implicitly and rapidly (De Houwer, 2014). Of course, the nature of the evaluation is dependent on subject characteristics and situational factors. For instance, a person with binge-eating disorder may evaluate a high-calorie food positively whereas a person with anorexia nervosa may evaluate it negatively. Similarly, when people are hungry, they may evaluate a high-calorie food more positively compared to when they are full.

After the evaluation of stimuli, corresponding approach-avoidance tendencies arise. Approach-avoidance tendency is the energization (i.e. preparedness) of approach-avoidance response, which may or may not end up with an executed response (Elliot, 2006). For instance, when the high-calorie food is evaluated positively, an approach tendency arises; in other words, the person tends to approach the food. On the other hand, when the high-calorie food is evaluated negatively, an avoidance tendency arises; in other words, the person tends to avoid the food. Thus, tendency can be conceptualized as the mediator between stimulus and response

(Elliot & Covington, 2001; see also “motivational orientation” in Strack & Deutsch, 2004). However, it should be emphasized that there is a possible dissociation between tendency and response: Tendency precedes response, but response does not have to occur just because there is a tendency (Elliot et al., 2013). For instance, on top of a bungee jumping platform, there may be a tendency to not jump (i.e. avoidance tendency). As a result of this tendency, one person may leave the platform (i.e. avoidance response); whereas another person may jump despite the avoidance tendency (i.e. no avoidance response).

Approach-avoidance tendency is a construct which can be used to explain what happens in the organism between stimulus and response. However, in order to be validated as a scientific construct, approach-avoidance tendency should be investigated empirically. Of course, investigations of approach-avoidance tendency cannot be as straightforward as investigations of approach-avoidance response, since it cannot be observed directly. Neither can we infer the tendency’s presence directly from the response, because people are capable of doing what they tend not to do, and not doing what they tend to do. Asking people what they tend (not) to do would give us information, but people may be unaware of those tendencies themselves, depending on how automatic the tendency is, i.e., how rapid, unintentional, uncontrolled, unconscious, and implicit it is (Moors, 2010). For instance, a driver who stops immediately after seeing a child running into the road would have an instant avoidance tendency which the driver would not be aware of at that moment.

Similarly, when a socially anxious person sees an angry face, a rapid avoidance tendency may occur before the person realizes this. On the other hand, when a person who feels lonely thinks of texting an ex-partner, the approach tendency before texting can be consciously observed. (One can argue that this tendency is indeed an avoidance tendency, since its function is to eliminate the negative feeling of loneliness. In any case, the tendency is about texting the ex-partner. Person may experience this tendency like an urge/impulse.)

An essential determinant in terms of investigating approach-avoidance tendencies – i.e. the automaticity of the tendencies – is indeed an important investigation topic in itself. In a sense, all tendencies are automatic since they are induced by stimuli. However, some tendencies may be more automatic than others (Moors, 2010). This means that they may have only some features of automaticity (e.g. unconscious but not rapid, unintentional but not implicit etc.), or that the features are present to different degrees (e.g. more rapid, less implicit etc.). For instance, consider a person who imagines his graduation day in order to motivate himself for writing his thesis. In this scenario, an approach tendency towards writing the thesis is quite intentional, conscious, and slow. On the other hand, consider a person who is exposed to a positive priming stimulus at a subliminal level before the presence of a target stimulus (and let's assume that this priming is effective.) In this scenario, an approach tendency towards the target stimulus is completely unintentional, unconscious, and very rapid; thus, it is "very automatic."

As mentioned above, we cannot observe automatic tendencies directly. We can only make inferences about them based on measured responses (behavioral choices, response times, physiological changes etc.), and what we measure is dependent on how we measure it (De Houwer, 2009). Depending on the specificity of the measurement method, tendency's level of automaticity which we can infer changes. For instance, if we measure the time it takes a phobic person to approach a feared object, and compare it with other people or other objects, we would measure the automatic avoidance tendency from that object, in units of minutes or hours. On the other hand, if we measure the time it takes a phobic person to pull a lever to approach a picture of the feared object on a computer screen, and compare it with other people or other objects, we would measure the automatic avoidance tendency from that picture, in units of milliseconds or seconds. In both scenarios, it is assumed that a slower response indicates the task is harder and a faster response indicates the task is easier. In terms of investigating automaticity of the approach-avoidance tendency, observation of the automatic avoidance tendency in the latter scenario would be more informative: We would be able to conclude that the avoidance tendency arises at a greater level of automaticity. Indeed, response time is a useful means to investigate the automaticity of approach-avoidance tendency since it can be used for different levels of automaticity within different contexts.

1.2. Investigating Automatic Approach-Avoidance Tendencies with Approach-Avoidance Tasks

With a prototypical approach-avoidance task, a preliminary study (Solarz, 1960) in which participants used their arms to approach or avoid positive and negative stimuli on a table showed the compatibility effect: Responses were faster when participants approached positive stimuli and avoided negative stimuli (compatible condition), compared to when participants approached negative stimuli and avoided positive stimuli (incompatible condition). Later, another important study (Chen & Bargh, 1999) showed the compatibility effect even when participants used a lever to approach or avoid positive and negative stimuli on a computer screen, and more importantly, even when responses were not executed based on the affective valence of stimuli: participants pulled the lever (i.e. avoidance) for half of the stimuli (composed of both positive and negative stimuli) and pushed the lever (i.e. approach) for the other half of the stimuli (composed of both positive and negative stimuli). Thus, participants did not evaluate the stimuli explicitly, which made the measurement more specific in terms of the level of automaticity. As a result, more automatic approach-avoidance tendencies could be inferred.

To date, there have been many approach-avoidance tasks which varied in terms of response modality, response criteria, and visual feedback (Phaf, Mohr, Rotteveel, & Wicherts, 2014). Response modality may be pushing and pulling (a lever, joystick, mouse etc.) or pressing buttons. Response criteria may be explicit (based on relevant stimulus content such as good vs. bad words) or implicit (based on stimulus form such as blue vs. yellow words). The advantage of explicit criteria is that they yielded stronger compatibility effects (Phaf et al., 2014). The advantage of implicit criteria is that different categories of stimuli other than "positive and negative stimuli" can be investigated, and more automatic tendencies can be inferred since participants are less focused on the stimuli and they respond faster. After the response, a visual feedback may be given as if the stimulus moves toward/away from the person, or the person moves toward/away from the stimulus. In addition, the visual feedback may be based on a character on the screen (i.e. a manikin moves toward/away from the stimulus).

There are two common examples of approach-avoidance tasks, distinguished based on the response modality and visual feedback: the Manikin Task (MT; though this term was not used in the original paper; De Houwer, Crombez, Baeyens, & Hermans, 2001) and the Approach Avoidance Task (AAT; Rinck & Becker, 2007). In MT, participants use buttons for approach and avoidance movements. First, a manikin and a stimulus appear on the screen. Then, participants press the button corresponding to the relative location of stimulus for approaching and the button corresponding to the relative location of manikin for avoiding. In order to create a visual feedback of approach and avoidance, manikin moves toward (i.e. approach) or moves away from the stimulus (i.e. avoidance). Thus, approach and avoidance representations are based on the movement of the manikin. In AAT, approach and avoidance movements are executed via pulling and pushing of a joystick, respectively. There is only a stimulus on the screen (often with a background). When participants pull the joystick, a visual feedback of approach occurs. When participants push the joystick, a visual feedback of avoidance occurs. In order to create a visual feedback of approach and avoidance, stimuli on the screen get bigger (i.e. zoomed in) after pulling and smaller (i.e. zoomed out) after pushing. Thus, approach and avoidance representations are based on the movement of the stimuli.

1.2.1. Visual Approach/Avoidance by the Self Task (VAAST)

In general, Manikin-like tasks showed larger compatibility effects than AAT-like tasks which sometimes failed to replicate the expected effects or even showed the opposite effects, possibly due to ambiguity in the meanings of arm movements: pushing and pulling can represent both approach and avoidance depending on the context (Rougier et al., 2018). Based on the premises that movement of the whole self represents approach-avoidance better than movement of the arms, and the visual aspect of this movement is more important than the motor aspect, Rougier et al. (2018) developed the VAAST and conducted a series of experiments which showed that visual feedback as if the person moves toward/away from the stimulus produces the strongest compatibility effect. Thus, in contrast to AAT, VAAST does not only change the size of stimuli but also the background scene (they get bigger when approaching and smaller when avoiding), imitating a whole-body movement rather than just pushing and pulling something. In addition, participants use buttons instead of a joystick so there is no confusion about interpretation of arm movements (forward button represents approach and backward button represents avoid). In fact, one experiment in the study showed that forward and backward buttons are not even necessary, left and right buttons also work with the same effectiveness as long as visual feedbacks continue. This finding is concordant with other findings from approach-avoidance tasks: the compatibility effect was observed when approach-avoidance movements on the screen were created by left-right movements (Eder & Rothermund, 2008) and reversed movements (Krieglmeyer, De Houwer, & Deutsch, 2011; Reichardt, 2018a) of the joystick, even when the responses required complex cognitive processing (Reichardt, 2018b).

Later, an online and easy-to-use version of the VAAST was created, showing similar large effects to those yielded by the lab version (Aubé, Rougier, Muller, Ric, & Yzerbyt, 2019). In addition, even though the lab version contained only positive and negative words as stimuli (Rougier et al., 2018), the online-VAAST showed that positive and negative pictures also produce similar effects (Aubé et al., 2019). It should be noted that response criteria were explicit for all (online) VAAST studies: participants needed to explicitly evaluate the affective valence of the stimuli (good vs. bad) and responded based on this deliberate process. To our knowledge, the VAAST has never been used with implicit response criteria. In fact, the (online) VAAST has been rarely used in general, since the tool has been developed only recently.

1.3. Automatic Approach-Avoidance Tendencies and Psychopathology

The fact that approach-avoidance tasks can be used for investigating automatic approach-avoidance tendencies for positive-negative stimuli enables us to investigate automatic approach-avoidance tendencies for other kinds of stimuli, too. First, rather than using positive-negative stimuli, negative-neutral or positive-neutral stimuli can be used. When negative and positive stimuli are used simultaneously, it is impossible to disentangle automatic approach and avoidance tendencies. When negative and neutral stimuli are used, on the other hand, the automatic avoidance tendency can be specifically investigated: There is an automatic avoidance tendency if responses are slower for approaching negative stimuli compared to neutral stimuli and faster for avoiding negative stimuli compared to neutral stimuli. In this scenario, response time for approach movement also becomes an indicator of an automatic avoidance tendency. Second, stimuli which are predicted to have more/less affective valence for some people (e.g. people with specific psychological disturbances) can be used to investigate approach-avoidance tendencies related to these stimuli. For instance, snake pictures can be used to investigate whether these pictures induce a stronger automatic avoidance tendency in snake-phobics compared to a control group. This is an important application because some psychopathologies could involve excessive or insufficient approach-avoidance tendencies for specific domains. For instance; depression can be thought to involve insufficient approach tendency, addiction can be thought to involve excessive approach tendency, antisocial personality can be thought to involve insufficient avoidance tendency, and agoraphobia can be thought to involve excessive avoidance tendency.

A possible benefit of investigating automatic approach-avoidance tendencies (i.e. investigating how automatic these tendencies are) would be that we may have more information about the underlying mechanisms of psychological problems. For instance, in cognitive theory of psychopathology, specific biases in information-processing are thought to be the cause of specific disorders (Beck & Haigh, 2014). From this perspective, faulty interpretations of internal/external stimuli yield to distress and maladaptive approach-avoidance responses, which in turn exacerbate the distress. However, if approach-avoidance tendencies arise very automatically (i.e. very fast and even when not thinking about the stimulus itself), it would mean that these tendencies may start even before interpreting the stimuli because verbal interpretation of a stimulus is a relatively slow and explicit process. Of course, faulty interpretations may still contribute to the psychological problems, but if approach-avoidance tendencies arise before the verbal interpretations, in addition to cognitive re-appraisal, interventions such as cognitive bias modification (see Discussion) may be integrated to the psychotherapy. On the other hand, if approach-avoidance tendencies are not that automatic, and if they are indeed the result of the verbal interpretations of the stimuli, then psychotherapy may be mainly focused on the mediating interpretations. Thus, in order to understand psychological problems better and develop more effective psychotherapies for them, investigating automatic approach-avoidance tendencies is important.

In fact, many studies investigated automatic approach-avoidance tendencies for various psychiatric disorders including substance use disorders, eating disorders, mood disorders, OCD, PTSD, specific phobias, social anxiety disorder, sexual disorders, and personality disorders (Loijena, Vrijsend, Eggera, Becker, & Rinck, 2020); as well as disturbances like attachment anxiety (Dewitte, De Houwer, Buysse, & Koster, 2008) and rumination in bereavement (Eisma et al., 2015). Approach-avoidance tasks may become especially useful if the underlying tendency (approach vs. avoidance) is not clear for a disturbance. For instance, a study which examined body dissatisfaction in males with an approach-avoidance task found that there was an automatic approach tendency toward muscular bodies but not an automatic avoidance tendency from overweight bodies (Dondzilo, Rodgers, Turnbull, & Bell, 2019). Another study which compared anorexia nervosa patients and a control group showed that the patients did not have stronger automatic avoidance tendency from high-calorie foods, but they had weaker automatic approach tendency towards them (Paslakis et al., 2016).

Even though approach-avoidance tasks can be used for investigating automatic approach and avoidance tendencies, we are interested in automatic avoidance tendencies in this work, because avoidance is a key feature of a wide spectrum of psychological disturbances, as demonstrated by the fact that different diagnoses in DSM-5 contain avoidance as a criterion (American Psychiatric Association, 2013; Krypotos, Effting, Kindt, & Beckers, 2015). Specifically, we are interested in automatic avoidance tendency from contamination-related stimuli. There are three reasons for this choice. First, contamination aversion (i.e. anxiety and/or disgust towards contamination) is easily provoked, powerful, universal, and strongly associated with (harm and/or disgust) avoidance (Rachman, 2004; Adams, Willems, & Bridges, 2011; Melli, Chiorri, Carraresi, Stopani, & Bulli, 2015). Second, it is very easy to find and use contamination-related stimuli. Third, the automatic avoidance tendency from contamination-related stimuli is a rarely studied subject (we found only three studies on this topic).

1.4. Previous Research on Automatic Avoidance Tendency from Contamination-Related Stimuli

The first study (Najmi, Kuckertz, & Amir, 2010) performed a median-split based on participants' scores on the contamination subscale of the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). The low contamination (LC) group consisted of 21 participants and the high contamination group (HC) group consisted of 20 participants. Six contamination-related and six neutral pictures were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1997). In AAT, there were 16 practice trials (with another set of pictures) and 288 assessment trials [6 pictures × 2 picture types (contamination/neutral) × 2 colors (blue/green) × 12 repetitions]. Data were analyzed by collapsing across pictures, i.e., for each person, median response times for contamination pictures and neutral pictures were computed. Median response times were submitted to 2 (group: HC, LC) × 2 (picture type: contamination, neutral) ANOVA's, separately for pushing and pulling movements. For pushing, there was a significant effect of group: responses were slower in HC group compared to LC group. However, there was no significant effect of picture type or interaction of picture type and group. For pulling, there was only a significant interaction between group and picture type: HC group was slower at pulling contamination pictures than neutral pictures, but this difference did not exist for LC group. In addition, contamination symptom scores were moderately correlated with response time differences between contamination and neutral pictures for pulling, but there was no correlation for pushing.

In the second study (Amir, Kuckertz, & Najmi, 2013), 44 participants were chosen based on their score (2 SD above the population mean) on the contamination subscale of the Maudsley Obsessional Compulsive Inventory (MOCI; Hodgson & Rachman, 1977). In this study, there were 72 assessment trials [3 pictures × 2 picture types (contamination/neutral) × 3 colors (blue/green/beige) × 4 repetitions]. Beige pictures were just filler trials without approach/avoidance movements and not analyzed. Again, data were analyzed by collapsing across pictures. Median response times were submitted to *t*-tests, separately for pushing and pulling movements. For pushing, there was not a difference between contamination and neutral pictures. For pulling, responses were slower for contamination pictures compared to neutral pictures, but this difference was not significant.

In the third study (Cludius, Külz, Landmann, Moritz, & Wittekind, 2017) there were 35 OCD patients with contamination-related symptoms, and 30 control participants. Initial pictures were chosen from the IAPS (Lang et al., 1997), the Berlin Obsessive-Compulsive Disorder Picture Set (BOCD-PS; Simon, Kischkel, Spielberg, & Kathmann, 2012), and flickr.com. Ten psychologists with experience diagnosing OCD chose six contamination pictures (from initial pictures), six neutral pictures, six contamination words, and six neutral words. There were eight practice trials (with different stimuli) and 144 assessment trials [18 stimuli × 2 stimulus modes (picture, word) × 2 colors (orange, blue) × 2 repetitions]. Data were analyzed by collapsing across stimuli, i.e., for each person, average response times for contamination stimuli and neutral stimuli were computed (there was not a significant effect of stimulus mode, so response times were collapsed across stimulus mode, too). Average response times were submitted to a 2 (group: patients, controls) × 2 (movement: push, pull) × 2 (stimulus type: contamination, neutral) ANOVA. There was only a significant interaction between group and stimulus type: patients' responses were slower for contamination stimuli compared to neutral stimuli, relative to those of the control group. In addition, contamination symptom scores were not correlated with response time differences between contamination and neutral pictures.

1.5. Present Study

In the present study, we tried to improve the methodology of the previous studies which investigated the automatic avoidance tendency from contamination-related stimuli. As an approach-avoidance task, we used the online-VAAST which is probably a better tool than AAT for assessing automatic approach-avoidance tendencies, as discussed above. Compared to the previous studies, we used more practice trials in order to eliminate the confounds such as fatigue and learning effects. In addition, we used more stimuli than previous studies, in order to increase the generalizability and cover the diversity of contamination-related stimuli. We chose contamination-related pictures from picture sets which were validated in terms of provoking contamination symptoms, rather than choosing pictures from picture sets which were only validated in terms of positive-negative valence. We also asked participants to rate how disturbing they find each picture on a scale of 0 to 10; and we used these scores in analyses, too. In addition, we used the contamination symptom scores as a continuous predictor in analyses, rather than performing a median split and dichotomizing a naturally continuous variable, which was shown to be problematic (Irwin & McClelland, 2003).

We added movement (approach vs. avoid) as a variable in our analyses, rather than conducting two separate analyses for approach and avoidance movements, like Najmi et al. (2010) and Amir et al. (2013) did. This is because separate analyses are not able to test the interaction between movement and other variables. In addition, with separate analyses, generalizability of other effects is reduced, and comparison of such effects for different movement conditions is not possible. For instance, in Najmi et al.'s (2010) study, there was a significant effect of group on response times (the HC group was slower than the LC group) in approaching condition but not in avoiding condition. From this, we cannot infer whether the HC group responded slower overall. Likewise, we cannot infer that HC group responded slower in approaching "compared" to avoiding, since a null finding in another statistical test cannot be used as evidence for the absence of an effect.

Most importantly, all of the previous studies used linear models (ANOVA, *t*-test, regression) by computing each person's average score for each stimulus type, which consisted of multiple stimuli. This means ignoring the differential effects of stimuli within a stimulus type. For instance, a picture of a toilet may create a stronger automatic avoidance tendency for some participants whereas a picture of dead animal may create a stronger automatic avoidance tendency for others. Since stimuli are sampled from a large population of stimuli in the same way participants are, a more general analytic approach which is called mixed modelling should be used in order to take into account both participants and stimuli as multiple sources of variation (Judd, Westfall, & Kenny, 2012, 2017). Using mixed models increases the accuracy and generalizability of findings as well as statistical power, while reducing Type I errors (Singmann & Kellen, 2019). For these reasons, we used mixed modelling in our analyses.

With all of these improvements, we aimed to investigate the automatic avoidance tendency from contamination-related stimuli more effectively than the previous studies. We had three main hypotheses. Hypothesis 1: As people's contamination symptom scores increase, they find contamination pictures (but not neutral pictures) more disturbing. We expected this hypothesis to be supported even after controlling for participants' depression, anxiety, stress, and fear of Covid-19 symptoms in our analyses. Hypothesis 2: More disturbing pictures induce automatic avoidance tendencies more strongly. Specifically, responses are slower for approaching more disturbing pictures, and faster for avoiding them. We expected this hypothesis to be supported even after controlling for participants' gaming experience in our analyses. Hypothesis 3: Contamination pictures induce automatic avoidance tendencies more strongly for people who have more contamination symptoms. Specifically, as people's contamination symptom scores increase, their responses become slower for approaching contamination pictures (compared to neutral pictures), and faster for avoiding them. We expected this hypothesis to be supported even after controlling for participants' depression, anxiety, stress, and fear of Covid-19 symptoms as well as their gaming experience in our analyses. We also investigated whether the accuracy of responses (i.e. moving in the correct direction in the approach-avoidance task) is affected by how disturbing the pictures are and approach-avoidance movement (Hypothesis 4); or picture type (contamination vs. neutral), approach-avoidance movement, and contamination symptoms (Hypothesis 5).

CHAPTER 2

METHOD

2.1. Participants

In order to participate in the study, people were required to have a computer, internet connection, and a browser other than Safari. There were no additional limitations for participation, all native Turkish-speaking people were invited to the study. Participants were recruited via two sampling processes. The first was to ask acquaintances to participate in the study. All acquaintances were asked to share the study with others, too. We also used Facebook groups to share the link of the study. Those participants did not receive any compensation. The second was to install the study in the Research Points System of the Psychology Programme at Sabancı University. Those students received course credits after completing the study. Due to the peculiarity of the statistical analyses which were used in the study, no power analysis had been done. We aimed to collect a sample as large as possible. We had started collecting data on February 27, 2021. In accordance with our stopping rule, data collection was finished on April 8, 2021.

119 participants were recruited with the first sampling process (acquaintances and social media), and 146 participants were recruited with the second sampling process (Sabancı University). 36 participants with current psychiatric/neurological diagnoses, three participants who did not complete the self-report measures, and six participants who had more than one missed item in any scale were excluded from all analyses (see Analyses for detailed information on exclusion criteria.) Of the 220 participants, 132 were females, 87 were males, and one did not want to answer the question. There were five people above 35 years old (only one of them was above 45), and 14 people below 18 years old. Most of the participants were in their twenties (N = 173). In total, mean age was 23.7 (SD = 5.43).

2.2. Instruments

2.2.1. Online Visual Approach/Avoidance by the Self Task (Online-VAAST)

The online-VAAST was programmed in PsyToolkit (https://www.psytoolkit.org/; Stoet, 2010, 2017) by Aube et al. (2019). Based on the PsyToolkit script which they provided, we re-programmed the task to incorporate our changes. The most important change was to use an implicit response criterion: we used pictures with colored frames, and asked participants to respond based on the color of the frame rather than picture content. For the sake of simplicity, we will not state the other changes we made, we will only describe our version of the task (for the original task; see https://www.psytoolkit.org/experiment-library/vaast_images.html).

There were two versions of our task, differing based on the color-movement instructions. In one version participants were told to “move towards pictures with blue frames and move away from pictures with yellow frames” and in the other version participants were told to “move towards pictures with yellow frames and move away from pictures with blue frames.” Participants were randomly assigned to one of these two versions. Other than that, instructions were the same for all participants. (See Appendix A for the instructions.). They were told to start a trial by pressing “H”, move forward by pressing “Y”, and move backward by pressing “N”. After the instructions, 80 practice trials were completed. Then, they were reminded of the movement instructions, and the 80 main trials were completed.

For the 80 practice trials, there were eight blocks with the same 10 neutral pictures. In the first block, five pictures had blue frames and five pictures had yellow frames. In the second block, every picture was presented again, but with the other frame color. For instance, if a picture had blue frame in the first block, it had yellow frame in the second block. These two blocks were repeated four times, making eight blocks in total. 10 pictures were presented in a random order in each block for each participant. For the 80 main trials, there were two blocks with the same 40 pictures

(20 contamination pictures and 20 neutral pictures). Neutral pictures used in main trials were different than the neutral pictures used in practice trials. As in the practice trials, the same 40 pictures were presented twice: once with a blue frame (in one block) and once with a yellow frame (in the other block). In one block, pictures with even numbers had yellow frames and pictures with odd numbers had blue frames. In another block, pictures with even numbers had blue frames and pictures with odd numbers had yellow frames. The order of these two blocks was randomized for participants. 40 pictures were presented in a random order in each block for each participant. (See Appendix B for pictures in the task.)

At the beginning of each trial, a prefixation symbol “O” was displayed at the center of the background scene (a 3-D street view). Participants had to press “H” to start the trial. Then, a fixation symbol “+” replaced the prefixation symbol “O”, and remained for 800-2000 ms (this duration was set randomly for each trial.) After this, the fixation symbol disappeared and a 350 x 263 picture (with a blue or yellow frame) appeared at the center of the background. In both practice and main trials, if participants pressed “H”, a text “ERROR!” replaced the picture and remained for 700 ms. Then, a black screen was displayed for 500 ms, followed by the prefixation symbol for next trial. In practice trials, if participants responded incorrectly (i.e. pressing “Y” instead of “N” or vice versa), the same thing happened: “ERROR!” replaced the picture and remained for 700 ms. Then, a black screen was displayed for 500 ms, followed by the prefixation symbol for the next trial. If participants responded correctly, corresponding visual feedback was given (moving forward if "Y" is pressed and moving backward if "N" is pressed). In main trials, accuracy of the response did not matter, visual feedback was given based on what the participant did (i.e. which button was pressed). Thus, there was no "ERROR!" text after pressing "Y" or "N".

Visual feedback of moving forward was created by replacing initial picture and background with their zoomed-in versions. There were no colored frames for the zoomed-in pictures. After pressing Y, a bigger version (420 x 315) of the previous picture replaced it and remained for 50 ms, followed by a bigger version (504 x 379) of the previous picture replacing it and remaining for 50 ms, followed by a bigger version (604 x 454) of the previous picture replacing it. The last (i.e. the biggest) picture remained for 700 ms. Then, a black screen was displayed for 500 ms, followed by the prefixation symbol for next trial. Visual feedback of moving backward was created by replacing initial picture and background with their zoomed-out versions. There were no colored frames for the zoomed-out pictures. After pressing Y, a smaller version (280 x 210) of the previous picture replaced it and remained for 50 ms, followed by a smaller version (224 x 168) of the previous picture replacing it and remaining for 50 ms, followed by a smaller version (179 x 135) of the previous picture replacing it. The last (i.e. the smallest) picture remained for 700 ms. Then, a black screen was displayed for 500 ms, followed by the prefixation symbol for next trial. The size of the background was always the same

(1200 x 675) but was zoomed in or out by the same ratio as the pictures. Thus, what appeared in the background changed slightly, depending on the movement. (See Appendix C for screenshots from the task.)

2.2.2. Picture Sets

2.2.2.1. Berlin Obsessive Compulsive Disorder Picture Set (BOCD-PS) – Contamination Pictures

BOCD-PS (Simon et al., 2012) consists of 25 pictures for each OCD theme (e.g. contamination, symmetry/ordering, checking), 25 neutral pictures, and 25 aversive pictures. The OCD pictures were taken with a Sony cyber shot digital camera (image size: 1024×768 pixels). Three psychotherapists specialized in OCD determined the picture contents. 13 OCD patients and 13 healthy controls participated in the validation study of BOCD-PS. OCD symptoms were assessed with the Vancouver Obsessional Compulsive Inventory (VOCI; Thordarson et al., 2004). Participants rated each picture based on its potential to induce anxiety, arousal, and unpleasantness; on a scale of one (no) to nine (extreme). For OCD, neutral, and aversive pictures, average scores were computed. For average anxiety ratings, an ANOVA showed a significant effect of picture type (OCD/neutral/aversive) but not group (OCD/control). Most importantly, there was a significant interaction between group and picture type: for OCD stimuli, the OCD group reported more anxiety compared to the control group. On average arousal and unpleasantness, there were significant effects of picture type. On average unpleasantness, there was also a significant effect of group. Most importantly, for both measures, there were significant interactions between picture type and group: for OCD stimuli, the OCD group reported more arousal and unpleasantness compared to the control group. Lastly, average anxiety ratings of the contamination pictures were highly correlated with the contamination subscale of the VOCI (r = .80). Other than contamination pictures, the contamination subscale of the VOCI was not correlated with average anxiety ratings of any other OCD theme, except symmetry/ordering pictures (r = .40).

Pictures Which Were Used in The Present Study: We took 15 contamination-related pictures from the BOCD-PS: CW_10a (depicting a stool sample), CW_14 (depicting a pus sample), CW_29 (depicting an ashtray), CW_31 (depicting a toilet brush), CW_51 (depicting a dead bird), CW_52 (depicting a dead mouse), CW_62b (depicting a toilet), CW_63b (depicting another toilet), CW_65 (depicting dog feces near a foot), CW_69 (depicting shaking hands), CW_80a (depicting food in a garbage can), CW_81d (depicting a garbage bag in a bed), CW_82 (depicting a public garbage can), CW_88 (depicting a hand holding a handle in subway), CW_92a (depicting a hand holding a shopping cart). We chose the pictures based on their scores for OCD-relevance, given by the 3 therapists in the validation study. In addition, we tried to include various objects/situations, but we only chose pictures which (1) would not require cultural information and (2) could be easily understood.

2.2.2.2. Maudsley Obsessive–Compulsive Stimuli Set (MOCSS) – Contamination Pictures

MOCSS (Mataix-Cols, Lawrence, Wooderson, Speckens, & Phillips, 2009) consists of 50 pictures for each OCD theme, 50 neutral pictures, and 50 aversive pictures. OCD pictures were taken with a Canon Powershot S20 digital camera (image sizes were 640 x 480 and 480 x 640 pixels). Three clinicians with experience in OCD determined the picture contents. 33 OCD patients and 23 healthy controls participated in the validation study of MOCSS. OCD symptoms were assessed with the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). Participants were instructed to imagine themselves in situations which were related to the scene in the picture. After seeing the 50 pictures in a category, they rated the subjective anxiety they feel on a scale of zero (no anxiety) to eight (extreme anxiety). Thus, rather than giving a score for each picture, participants gave a score for each picture category. For anxiety ratings, an ANOVA showed significant effects of group (OCD/control) and picture type (contamination/neutral) but there was not a significant interaction between group and picture type. Anxiety ratings of contamination pictures were moderately correlated with the washing subscale of OCI-R (r = .58). There was no correlation between anxiety ratings of contamination pictures and other subscales of the OCI-R. In addition, even after controlling for depression, state anxiety, and general OCD symptom severity, anxiety ratings of contamination pictures were significantly predicted by the washing subscale of the OCI-R (R^2 change = .26).

Pictures Which Were Used in The Present Study: We took 5 contamination-related pictures from the MOCSS: W01b (depicting a toilet), W02 (depicting a sink), W20 (depicting a garbage bin), W25 (depicting a syringe in garbage), W35 (depicting garbage bags in a street). We chose these pictures in order to increase the number and the diversity of contamination pictures in our study.

2.2.2.3. Open Affective Standardized Image Set (OASIS)

OASIS (Kurdi, Lozano, & Banaji, 2017) consists of 900 pictures divided to four picture categories: scenes (*N* = 220), objects (*N* = 200), animals (*N* = 134), and people (*N* = 346). Pictures were found via Google Images (https://images.google.com). The size of the pictures was standardized to 500 x 400 pixels. 822 participants were asked to rate the valence and arousal of the pictures, using a 7-point Likert scale. Mean valence ratings (image-wise) ranged from 1.11 to 6.49, with the mean of 4.33 and the standard deviation of 1.09. Mean arousal ratings (image-wise) ranged from 1.69 to 5.72, with the mean of 3.67 and the standard deviation of 1.68. In order to assess the inter-item reliability, mean of the distribution of correlations between 1000 randomly generated split halves was used. For the valence ratings, inter-item reliability was .984 (*SD* = 0.002, range: R_{min} = .974 and R_{max} = .989). For the arousal ratings, inter-item reliability was .929 (*SD* = 0.015, range: R_{min} = .833 and R_{max} = .958). In order to assess face validity, pictures with the highest/lowest means/standard deviations of valence/arousal scores were checked. The most positive picture was a puppy in a coffee pot, the most negative picture was an emaciated person in a concentration camp. In terms of valence, the highest level of agreement was on a rooftop picture and the lowest level of agreement was on a heterosexual oral intercourse picture. The most arousing picture was depicting a heterosexual intercourse, the least arousing picture was a concrete wall. In terms of arousal, the highest level of agreement was on a picture depicting a pile of blank paper and the lowest level of agreement was depicting dead bodies lying on the ground. Lastly, soundness of OASIS was also supported by the similarity of valence and arousal distributions between OASIS and IAPS (Lang et al., 1997). Kolmogorov–Smirnov tests showed that the valence scores come from the same distributions (D = 0.04, p = .257), and that the arousal scores come from very similar distributions (D = 0.07, p = .023).

Pictures Which Were Used in The Current Study: We took 10 pictures from OASIS for practice trials. Pictures depicted (1) a line of alcohol glasses, (2) two babies, (3) billiard balls, (4) a cappuccino, (5) a snowman, (6) a large plastic duck, (7) a tree ornament, (8) a fire-breathing man, (9) fireworks above a city, (10) a lighting near a battleship. We took 20 pictures from OASIS for neutral pictures in the main trials. Pictures depicted (1) acorns, (2) barrels, (3) a sledge, (4) empty cups, (5) a fire hydrant near a wall, (6) flowers, (7) a heart shape in rails, (8) office objects, (9) blank paper, (10) paperclips, (11) penguins, (12) a quaint telephone, (13) a pigeon, (14) pinecones, (15) present boxes, (16) pebbles, (17) a soccer ball in a stadium, (18) a Buddha statue, (19) a swing, (20) yarns. 2 pictures were chosen from the animal category because there were 2 (dead) animals in our contamination pictures. 18 pictures were chosen from the object category. Pictures were chosen based on the visual and thematic similarity with the contamination pictures, especially in terms of the background scene. For the 20 pictures we chose, the mean valence was 5.38 and the mean arousal was 2.59.

2.2.3. Self-Report Measures

2.2.3.1. Vancouver Obsessional Compulsive Inventory (VOCI) – Contamination Subscale

The VOCI (Thordarson et al., 2004) was designed to measure obsessions, compulsions, and avoidance behaviors for different types of OCD. The contamination subscale consists of 12 items, with a 5-point Likert scale (see Appendix D). In the validation study, there were 88 adults with OCD diagnosis, 60 adults with anxiety and mood disorders (people with subclinical OCD were excluded), 39 community adults with no psychological disorders, and 200 undergraduate students with no psychological disorders. A factor analysis with OCD sample showed the distinct nature of the contamination subscale. For assessing test-retest reliability, 28 students and 28 adults with OCD were tested after 7-18 days the first test. The correlation between the two VOCI-Contamination scores was .97 for OCD group, and .53 for the students. Internal consistency (Cronbach's α) of VOCI-Contamination was .92 for OCD group, .92 for anxiety/mood disorders group, .79 for community adults, and .87 for students. Criterion validity of VOCI-Contamination was assessed via two different comparisons. First, Dunnett's method for multiple comparisons showed that the mean VOCI-Contamination score for the OCD group (*M* = 19.41, *SD* = 12.51) was higher than it was for the anxiety/mood disorder group (*M* = 7.10, *SD* = 8.96), community adults (*M* = 1.74, *SD* = 2.94), and students (*M* = 7.31, *SD* = 6.82), $p < .05$. Second, an independent-samples *t*-test showed that OCD sufferers with predominant contamination problems (*M* = 25.26, *SD* = 11.56) had higher VOCI-Contamination scores than other OCD sufferers (*M* =11.72, *SD* = 9.36), $t(85) = 5.88$, $p < .001$. For assessing convergent validity, the contamination/washing subscales of the Maudsley Obsessional Compulsive Inventory (MOCI; Hodgson & Rachman, 1977) and the Padua Inventory, Washington State University Revision (PI; Burns, Keortge, Formea, & Sternberger, 1996) were used. For assessing discriminant validity, the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger & Borkovec, 1990), the Beck Anxiety Inventory (BAI; Beck & Steer, 1993a), and the Beck Depression Inventory (BDI; Beck & Steer, 1993b) were used. In the OCD sample, VOCI-Contamination was highly correlated with PI-Contamination ($r = .90$) and MOCI-Contamination ($r = .83$) while it was weakly correlated with the BDI ($r = .22$), the BAI ($r = .10$), PSWQ ($r = .10$), and other subscales of the PI and MOCI (range of *r*'s between -.09 and .19), except one subscale of PI ($r = .40$). In the student sample, VOCI-Contamination was highly correlated with PI-Contamination ($r = .85$) and moderately correlated with MOCI-Contamination ($r = .59$) while it was weakly or moderately correlated with the BDI ($r = .27$), the BAI ($r = .31$), the PSWQ ($r = .48$) and other subscales of the PI and MOCI (range of r's between .12 and .48).

The Turkish adaptation of the VOCI (Inozu & Yorulmaz, 2013) was tested in 319 college students. In addition, data from 362 college students in Canada were used for comparison of the underlying factor structure. A target rotation analysis with two principal component analyses showed that the Turkish version of VOCI-Contamination was very similar to the original subscale, with a Tucker's Congruence Coefficient of .86. Internal consistency (Cronbach's α) of VOCI-Contamination was .89. For assessing convergent validity, Turkish version of PI-Contamination (Yorulmaz et al., 2007) was used. VOCI-Contamination was highly correlated with PI-Contamination (r = .75) while it was weakly or moderately correlated with other subscales of PI (range of r's between .22 and .53). For assessing criterion validity, participants with the highest and the lowest 25% of scores on the PI were compared in terms of their VOCI-Contamination scores, with a MANOVA. As expected, the highest PI group (M = 21.40, SD = 8.43) had higher scores of VOCI-Contamination than the lowest PI group (M = 5.35, SD = 4.96), $F(1,158) = 211.13$, $\eta^2_{partial} = .75$, $p < .001$.

2.2.3.2. Fear of Covid-19 Scale (FCV-19S)

The FCV-19S (Ahorsu et al., 2020) was designed to assess fear, anxiety, and worry about Covid-19. It consists of seven items, with a 5-point Likert scale (see Appendix E). A validation study was done with 717 Iranian adults. All items had corrected item-total correlations ranging from 0.47 to 0.56 and factor loadings ranging from 0.66 to 0.74. Internal consistency (Cronbach's α) was .82, test–retest reliability (ICC) was .72, composite reliability was 0.88, and standard error of measurement was 1.89. For concurrent validity, the Iranian Version of the Hospital Anxiety and Depression Scale (HADS; Montazeri, Vahdaninia, Ebrahimi, & Jarvandi, 2003) and the Iranian version of the Perceived Vulnerability to Disease Scale (PVDS; Ahmadzadeh, Ghamarani, Samadi, Shamsi, & Azizollah, 2013) were used. Fear of Covid-19 was moderately correlated to depression (r = .425), anxiety (r = .511), perceived infectability (r = .483), and germ aversion (r = .459).

The Turkish adaptation of the FCV-19S (Haktanir, Seki, & Dilmaç, 2020) was tested in 668 people. A confirmatory factor analysis showed that items had factor loadings ranging from .50 to .81. Internal consistency (Cronbach's α) was .86, and split-half reliability was .83. For assessing discriminant validity, the Brief Resilience Scale (BRS; Smith et al., 2008) was used. The FCV-19S had a negative moderate correlation with the BRS (r = -.32).

2.2.3.3. Depression Anxiety Stress Scale-21 (DASS-21)

The DASS-21 (Antony, Bieling, Cox, Enns, & Swinson, 1998) was developed from the DASS-42 (Lovibond & Lovibond, 1995) which assesses depression, anxiety, and stress symptoms. It consists of 21 items, with a 4-point Likert scale (see Appendix F). In the validation study of the DASS-21, there were 67 panic disorder patients, 54 OCD patients, 74 social phobia patients, 17 specific phobia patients, 46 major depressive disorder patients, and 49 healthy controls. An exploratory factor analysis with clinical groups suggested the three underlying factors of Depression-Anxiety-Stress; with higher mean-loadings and fewer cross-loading items than the DASS-42. Internal consistency (Cronbach's α) was .94 for Depression, .87 for Anxiety, and .91 for Stress. For assessing concurrent validity, the State Trait Anxiety Inventory-Trait (STAI-T; Spielberger, 1983), the Beck Anxiety Inventory (BAI; Beck & Steer, 1993a), and the Beck Depression Inventory (BDI; Beck & Steer, 1993b) were used. There were significant correlations between all of the scales: .57 for Stress and Depression, .72 for Stress and Anxiety, .69 for Stress and the BDI, .70 for Stress and the BAI, .68 for Stress and the STAI-T; .46 for Depression and Anxiety, .79 for Depression and the BDI, .51 for Depression and the BAI, .71 for Depression and the STAI-T; .62 for Anxiety and the BDI, .85 for Anxiety and the BAI, .55 for Anxiety and the STAI-T. For assessing criterion validity, different groups were compared with a series of ANOVA's. Healthy controls had lowest scores on all three scales. Major depressive disorder patients scored highest on Depression and Stress. Panic disorder patients scored highest on Anxiety.

The Turkish adaptation of the DASS-21 (Sariçam, 2018) was done with two studies. In the first study, there were 420 students from a certificate program. Exploratory factor analysis with 220 students and confirmatory factor analysis with 200 students suggested the same triple factor structure with the original study. For Stress, factor loadings were between .34 and .64; for Anxiety, they were between .39

and .63; for Depression, they were between .47 and .71. The corrected item total correlation coefficients were between .47 and .70 for Depression, between .30 and .64 for Anxiety, and between 0.44 and 0.59 for Stress. Internal consistency (Cronbach's α) was .85 for Depression, .80 for Anxiety, and .77 for Stress. For assessing test-retest reliability, 72 participants were tested again after 21 days. Correlation coefficients between first and second tests were .68 for Depression, .66 for Anxiety, and .61 for Stress. For assessing criterion validity, the DASS-42 (Lovibond & Lovibond, 1995) was used. The correlation between the DASS-21 and the DASS-42 was .89. The second study included 101 major depressive disorder patients. A confirmatory factor analysis suggested the same triple factor structure. For Stress, factor loadings were between .42 and .66; for Anxiety, they were between .44 and .65; for Depression, they were between .51 and .72. The corrected item total correlation coefficients were between .43 and .77 for Depression, between .47 and .67 for Anxiety, and between 0.44 and 0.68 for Stress. Internal consistency (Cronbach's α) was .87 for Depression and .81 for Stress. For assessing discriminant validity, 101 patients were compared with 220 students as controls, by using a Mann Whitney U test. Controls' Stress (M = 7.90, SD = 3.93), Anxiety (M = 5.37, SD = 3.88), and Depression (M = 5.88, SD = 4.33) scores were lower than patients' Stress (M = 11.85, SD = 4.59), Anxiety (M = 10.39, SD = 5.18), and Depression (M = 10.83, SD = 5.55) scores, respectively.

2.3. Procedure

After giving their informed consent, participants waited for the online-VAAST to load. This took a couple of minutes for some participants, depending on their internet connection. Participants were told to stay in full screen mode, which occurred automatically after they clicked to start the online-VAAST. After finishing the online-VAAST, participants were asked to rate how disturbing they found the pictures subjectively, on a scale of 0 (not disturbing at all) to 10 (too disturbing). 40 pictures (20 contamination-related and 20 neutral) from the main task were presented randomly for each participant. The size of the pictures was the same as the initial presentation of them in the online-VAAST (350 x 263), but the pictures had no colored frames. After rating the pictures, participants filled out the VOCI – Contamination Subscale, FCV-19S, DASS-21, in this order. We chose this particular order because we did not want to prime participants to think about Covid-19 when they were answering items about their more general concerns of contamination. In addition, DASS-21 was the longest and the least important scale for our purposes. After answering all items in a scale (there was an optional answer of "I do not want to answer" for each item), participants could continue to the next scale. From that point, previous scales could not be reached again.

After completing the scales, participants answered questions about their age, gender, presence of current psychiatric/neurological diagnoses and presence of past psychiatric/neurological diagnoses. If an answer was positive to the psychiatric/neurological questions, names of the diagnoses were asked in separate questions. Of course, there was an optional answer of “I do not want to answer” for gender and psychiatric/neurological questions. Lastly, participants answered if they have ever played a computer game in which a character is moved by keys. If they answered this question positively, they were presented with a series of questions on their computer gaming experience. Separately, they were asked both the (1) longest and (2) most recent periods of playing a computer game in which a character is moved by keys. End of those periods, duration of the periods, weekly gaming frequency (in unit of days), and average playing time (in unit of hours) on a game day were asked for both experiences (see Appendix G). Finally, participants were debriefed. The research question and hypotheses were shared with participants, while warning them to not share these with others. Participants were provided with a unique code which they can use if they want to erase their data at any point.

2.4. Analyses

Analyses were done with Jamovi (version 1.6; 2021). For the analysis of disturbingness ratings (Hypothesis 1), 36 participants with current psychiatric/neurological diagnoses, three participants who did not complete the self-report measures, and six participants who had more than one missed item in any scale were excluded (when there was only one missed item, it was replaced by the participant’s mean score for the scale). In the end, there were 8800 picture ratings coming from 220 participants (20 contamination and 20 neutral pictures for each participant.) For the analysis of response time (Hypotheses 2 & 3), the same 45 participants were excluded. In addition, the 80 practice trials were excluded. Subsequent exclusion criteria were based on the 80 main trials. First, four participants who had 10 or more incorrect responses and three participants who had 10 or more responses which are outside the range of 200 - 4000 ms were excluded. Second, all incorrect responses and responses outside the range of 200 - 4000 ms were excluded. Then, within-condition-within-participants outlier trimming was carried out: For each picture type - movement combination within each participant, response times more than 2.5 SD above and below the mean were excluded. In the end, there were 16405 trials coming from 213 participants (20 contamination and 20 neutral pictures for both approach and avoid conditions for each participant, minus the excluded trials). For the analyses of accuracy (Hypotheses 4 & 5), the same exclusion criteria with response time, except removing incorrect responses, were used. In the end, there were 16715 trials coming from 213 participants.

For testing the main hypotheses (1,2, & 3), we used linear mixed-effects modeling. Restricted Maximum Likelihood was used for estimation and the Satterthwaite method was used for approximating the degrees of freedom of fixed effects. For the analyses of Hypotheses 4 and 5, we used a generalized linear mixed-effects model with a binomial distribution and a logit link function. For all analyses, we chose a conservative α of .01 for significance testing. Random effects were assumed to be correlated. We mean-centered the continuous variables and applied a simple effects coding to the categorical variables. For the analyses of response time (Hypotheses 2 & 3), first, we compared “ln” and “inverse” transformations of response time (in order to create similar scales, we multiplied the inverse transformation with -1000 and added 8) in terms of their goodness of fit, based on the residual plots (with the pre-determined random effects structure). After choosing the inverse transformation for Hypotheses 2 and 3 (see Results), and at the beginning of analyses for the other hypotheses, we compared the models with and without highly correlated random effects. In the pre-determined random effects structure, there were random intercepts and random slopes for within-participants categorical variables. If removing the highly correlated random slope improved the model (i.e. smaller AIC/BIC values), we removed it. With the final model, the main analyses were done first (for testing the hypotheses), followed by additional analyses with extra variables.

2.4.1. Variables

“Response time” is the time in milliseconds between picture’s presentation and the participant’s pressing a button, with possible values of zero to infinity. “Accuracy” is being a correct response or not (pressing the right key or not), with the possible values of 1 (correct) and 0 (incorrect). “Movement” is the type of movement in a trial (i.e. pressed button), with the possible values of approach (moving forward by pressing Y) and avoid (moving backward by pressing N). “Picture type” is the content of the pictures, with the possible values of contamination and neutral.

“Instruction” is the version of the color-movement instruction, with the possible values of “approach blue, avoid yellow” and “approach yellow, avoid blue.” “Order” is the block order for presentation of pictures in the main trials, with the possible values of two orders (see Online-VAAST in Instruments). “Trial” is the number of previous trials for each trial, with the possible values of 0 to 159. “Disturbingness” is participants’ ratings of pictures depending on how disturbing they find the picture, with possible values of 0-10. “VOCI-Contamination” is the total score on the Contamination Subscale of the VOCI, with possible values of 0 to 48. “FCV-19S” is the total score on the FCV-19S, with possible values of 7 to 35. “DASS-Depression” is the total score on the Depression Subscale of the DASS-21, with possible values of 0 to 21. “DASS-Anxiety” is the total score on the Anxiety Subscale of the DASS-21, with possible values of 0 to 21. “DASS-Stress” is the total score on the Stress Subscale of the DASS-21, with possible values of 0 to 21. “Gaming score” is the participant’s previous experience with PC games involving a character being moved using a keyboard, with possible values of 0 to 58. “Study” is the type of sampling procedure, with the possible values of “Sabancı University” and “social media & friends”.

2.4.2. Pre-Determined Random Effect Structures for the Analyses

2.4.2.1. Hypothesis 1

Outcome: Disturbingness

Categorical Predictors (Factors): Picture Type

Continuous Predictors (Covariates): VOCI-Contamination

Fixed Effects: fixed intercept; fixed slopes for VOCI-Contamination and picture type; fixed slope for interaction of picture type and VOCI-Contamination

Random Effects: participant random intercept, picture random intercept; participant random slope for picture type

2.4.2.2. Hypothesis 2

Outcome: Response Time

Categorical Predictors (Factors): Movement

Continuous Predictors (Covariates): Disturbingness

Fixed Effects: fixed intercept; fixed slopes for disturbingness and movement; fixed slope for the interaction between disturbingness and movement

Random Effects: participant random intercept, picture random intercept; participant and picture random slopes for movement

(Picture random slope for movement was excluded from the analyses due to its high correlation with picture random intercept; see Results.)

2.4.2.3. Hypothesis 3

Outcome: Response Time

Categorical Predictors (Factors): Picture Type, Movement

Continuous Predictors (Covariates): VOCI-Contamination

Fixed Effects: fixed intercept; fixed slopes for picture type, movement, and VOCI-Contamination; fixed slopes for the interaction between picture type and movement, the interaction between picture type and VOCI-Contamination, the interaction between movement and VOCI-Contamination, the interaction between picture type, movement, and VOCI-Contamination

Random Effects: participant random intercept, picture random intercept; participant random slope for picture type, participant and picture random slopes for movement

(Picture random slope for movement was excluded from the analyses due to its high correlation with picture random intercept; see Results.)

2.4.2.4. Hypothesis 4

Outcome: Accuracy

Categorical Predictors (Factors): Movement

Continuous Predictors (Covariates): Disturbingness

Fixed Effects: fixed intercept; fixed slopes for disturbingness and movement; fixed slope for the interaction between disturbingness and movement

Random Effects: participant random intercept, picture random intercept; participant and picture random slopes for movement

(All random slopes were excluded from the analyses due to their high correlations with the random intercepts; see Results.)

2.4.2.5. Hypothesis 5

Outcome: Accuracy

Categorical Predictors (Factors): Picture Type, Movement

Continuous Predictors (Covariates): VOCI-Contamination

Fixed Effects: fixed intercept; fixed slopes for picture type, movement, and VOCI-Contamination; fixed slopes for the interaction between picture type and movement, the interaction between picture type and VOCI-Contamination, the interaction between movement and VOCI-Contamination, the interaction between picture type, movement, and VOCI-Contamination

Random Effects: participant random intercept, picture random intercept; participant random slope for picture type, participant and picture random slopes for movement

(All random slopes were excluded from the analyses due to their high correlations with the random intercept; see Results.)

CHAPTER 3

RESULTS

3.1. Hypothesis 1

It was expected that disturbingness scores would increase for contamination pictures compared to neutral pictures, as VOCI-Contamination scores increase (2-way interaction between VOCI-Contamination and picture type).

As can be seen in Figure 1, disturbingness scores were not normally distributed. However, we did not apply any transformation to this variable. With the fixed effects of picture type, VOCI-Contamination, and their interaction, as well as random intercepts and participant random slope for picture type, we examined the model. Residuals were not normally distributed but there was no visible violation of homoskedasticity or linearity (see Figure 2).

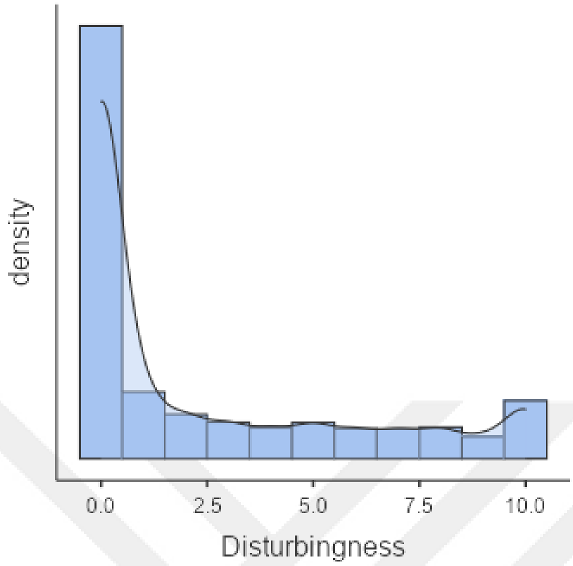

Figure 1. Distribution of Disturbingness Scores (Hypothesis 1).

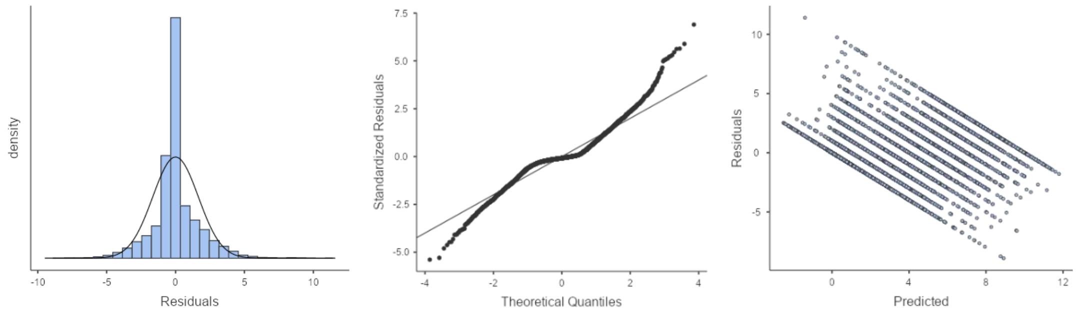

Figure 2. Residual Histogram, Q-Q Plot, and Residual Scatterplot (from Left to Right) for Hypothesis 1.

3.1.1. Comparison of Models with Different Random Effects

Since the correlation between participant random slope for picture type and participant random intercept was .965, we excluded the participant random slope for picture type to see whether the model improved, but it did not. The model with participant random slope for picture type (AIC: 35226.295, BIC: 35306.996) was better than the model without it (AIC: 37028.453, BIC: 37095.667) so we chose the model with participant random slope for picture type for the main analysis. Residuals of random effects were not normally distributed, especially for the picture random intercept (see Figure 3).

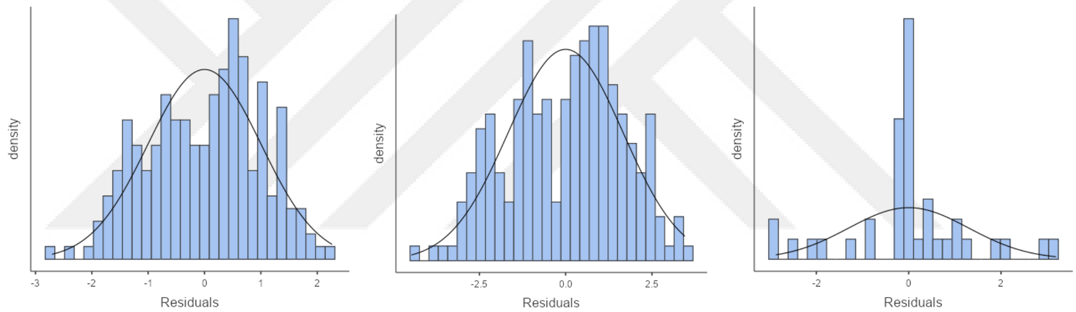

Figure 3. Residual Histograms of Participant Random Intercept, Participant Random Slope for Picture Type, and Picture Random Intercept (from Left to Right) for Hypothesis 1.

3.1.2. Main Analysis

There were significant effects of picture type, VOCI-Contamination, and their interaction (see Table 1). Contamination pictures had higher disturbingness scores than neutral pictures. More importantly, the difference between contamination pictures and neutral pictures became larger as VOCI-Contamination scores increased (see Table 2 and Figure 4). Thus, results supported the Hypothesis 1.

Table 1

Fixed Effects Parameter Estimates for Hypothesis 1

Names	**Effect**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
(Intercept)	(Intercept)	2.433	0.22	[2.001, 2.865]	46.7	11.04	< .001
Picture Type	Contamination - Neutral	4.282	0.434	[3.432, 5.133]	44	9.86	< .001
VOCI	VOCI	0.064	0.009	[0.047, 0.081]	218	7.49	< .001
Picture Type × VOCI	Contamination - Neutral × VOCI	0.102	0.015	[0.073, 0.13]	218	7.02	< .001

Table 2

Simple Effects of Picture Type: Parameter Estimates (Hypothesis 1)

VOCI	**Contrast**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
Mean - 1 SD	Contamination - Neutral	3.43	0.451	[2.53, 4.34]	50.9	7.61	< .001
Mean	Contamination - Neutral	4.28	0.434	[3.41, 5.16]	44.0	9.86	< .001
Mean + 1 SD	Contamination - Neutral	5.13	0.451	[4.23, 6.04]	50.9	11.39	< .001

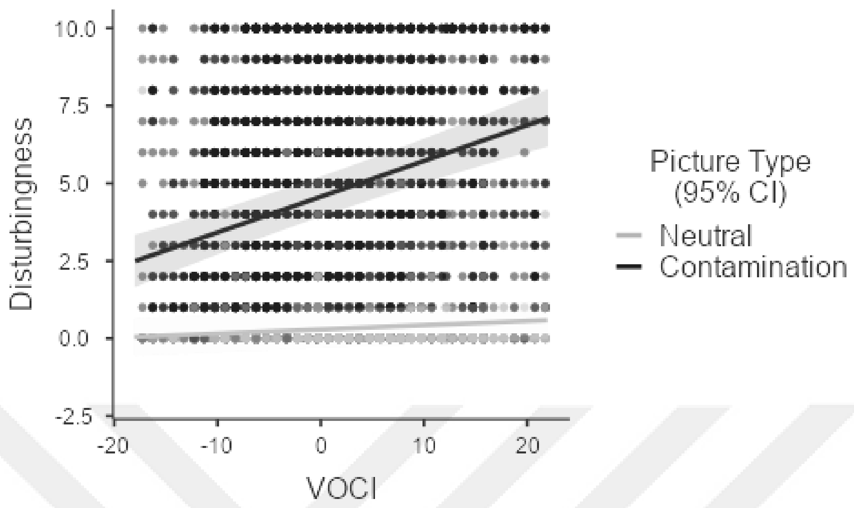

Figure 4. Relationship between VOCI-Contamination and Disturbingness Scores, Separately for Neutral and Contamination Pictures (Hypothesis 1).

3.1.3. Additional Analyses

When FCV-19S, DASS-Depression, DASS-Anxiety, DASS-Stress, and their 2-way interactions with picture type were added to the main model, there was only a significant FCV-19S and picture type interaction, $F(1, 214) = 7.074$, $p = .008$ (in addition to significant effects of picture type, VOCI-Contamination, and their interaction). However, when DASS subscales were excluded while age, gender, study, and their 2-way interactions with picture type were included to the model, the interaction between FCV-19S and picture type disappeared. Rather, there was only a significant gender and picture type interaction, $F(2, 212) = 13.113$, $p < .001$ (in addition to significant effects of picture type, VOCI-Contamination, and their interaction). Females had slightly higher disturbingness scores for contamination pictures (see Figure 5). With the participant-wise data, an ANOVA with gender as the independent variable and FCV-19S as the dependent variable showed that females had higher FCV-19S scores (M = 18.1, 95% CI [17.19, 19]) compared to males (M = 14.2, 95% CI [13.15, 15.3]), $F(2, 217) = 14.9$, $\eta^2 = .121$, $p < .001$. Thus, the significant FCV-19S and picture type interaction in the model without gender was probably due to the associations between FCV-19S and gender, and between gender and picture type.

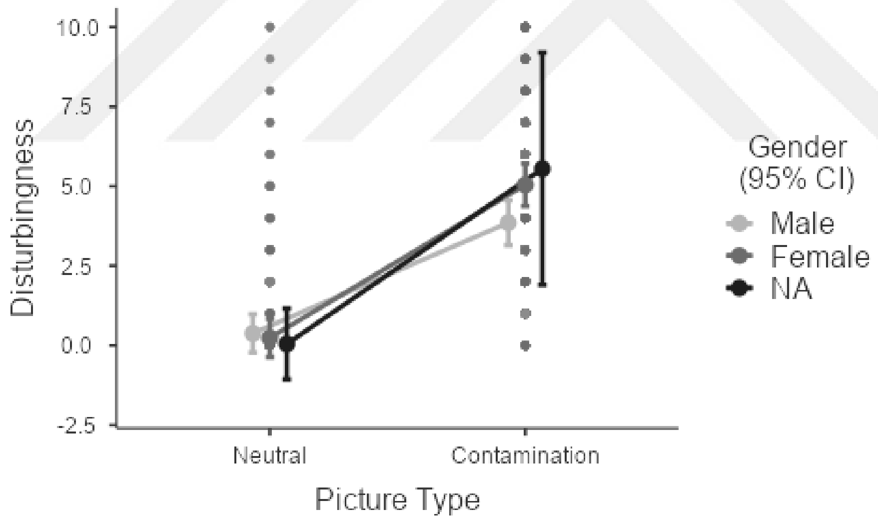

Figure 5. Relationship between Picture Type and Disturbingness Scores, Separately for Males and Females (Hypothesis 1).

3.2. Hypothesis 2

It was expected that response times increase for approaching pictures and decrease for avoiding them, as disturbingness scores of the pictures increase (2-way interaction between disturbingness and movement).

3.2.1. Comparison of Models with Different Transformations

With the fixed effects of disturbingness, movement, and their interaction as well as random intercepts, picture random slope for movement, and participant random slope for movement; we compared the models with “ln” and “inverse” transformations of response time (see Figure 6). In terms of normality, there was not a visible difference. In terms of homoskedasticity, the model with the ln transformation seemed worse because the residuals were smaller (showed less variance) for smaller predicted values in the model. Thus, we did the subsequent analyses with inverse response time as the dependent variable.

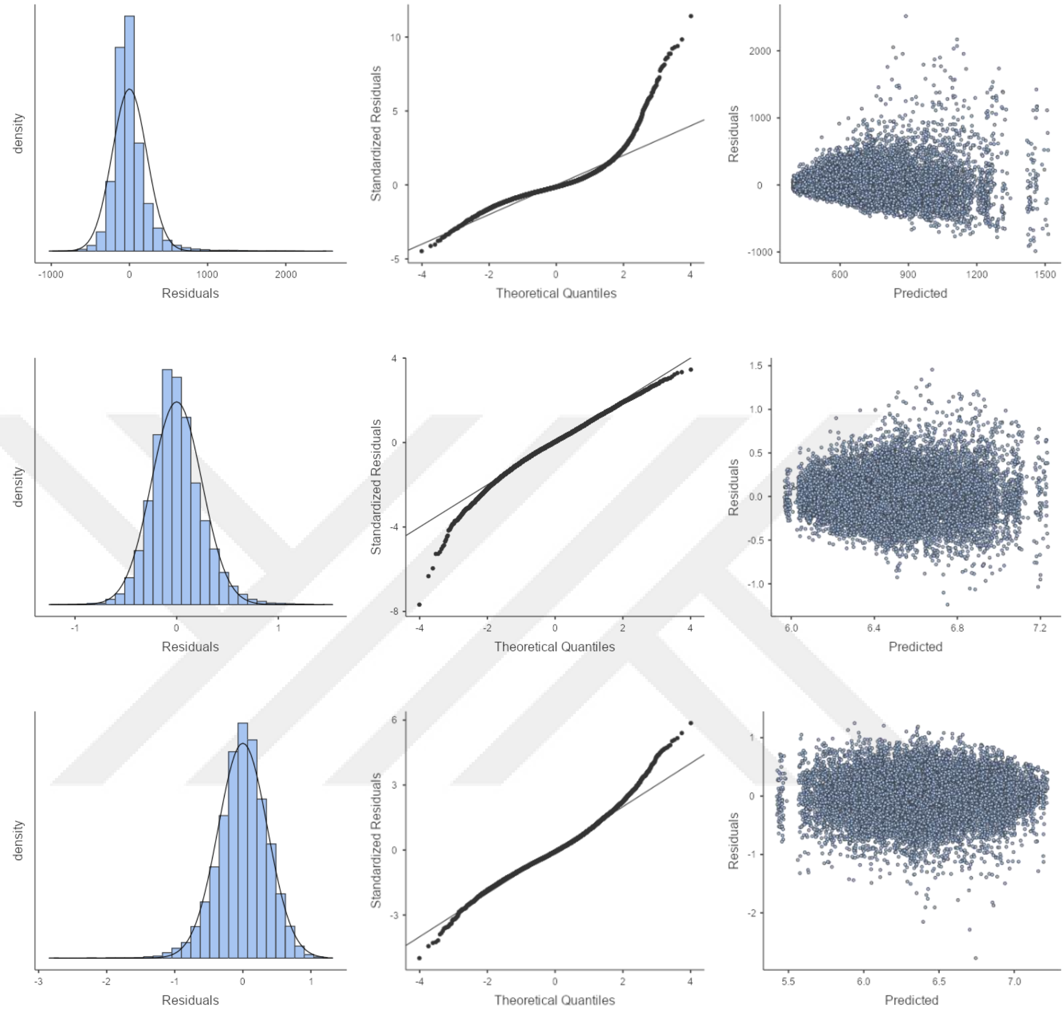

Figure 6. Residual Histograms, Q-Q Plots, and Residual Scatterplots (from Left to Right) of Raw Response Time, Ln Response Time, and Inverse Response Time (from Top to Bottom) for Hypothesis 2.

3.2.2. Comparison of Models with Different Random Effects

Since the correlation between picture random slope for movement and picture random intercept was 1, we excluded the picture random slope for movement to see whether the model improved. The model with picture random slope for movement (AIC: 14712.147, BIC: 14832.774) was worse than the model without it (AIC:

14708.149, BIC: 14813.365) so we chose the model without picture random slope for movement for the main analysis. The residuals of the random effects were not normally distributed, especially for the picture random intercept (see Figure 7).

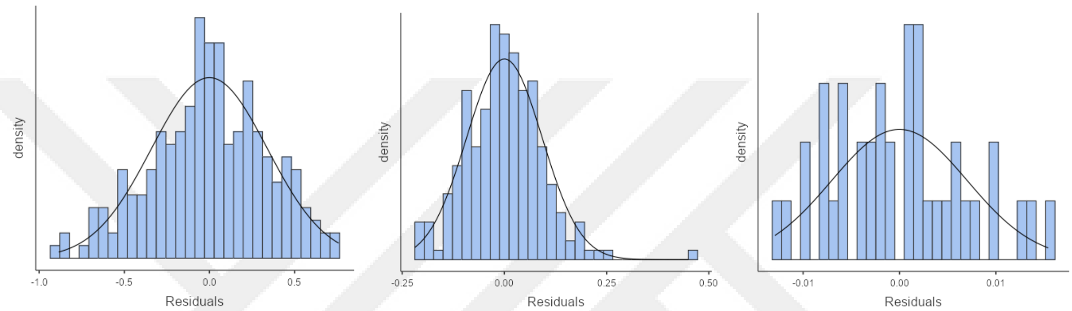

Figure 7. Residual Histograms of Participant Random Intercept, Participant Random Slope for Movement, and Picture Random Intercept (from Left to Right) for Hypothesis 2.

3.2.3. Main Analysis

There was only a significant effect of disturbingness: more disturbing pictures caused slower responses (see Table 3). Thus, results did not support the Hypothesis 2. Simple effects analysis showed that the simple main effect of disturbingness was significant for the approach movement but not for the avoid movement, and the positive association between disturbingness and response time was stronger for approach movement (see Table 4).

Table 3

Fixed Effects Parameter Estimates for Hypothesis 2

Names	**Effect**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
(Intercept)	(Intercept)	6.418	0.024	[6.371, 6.464]	216	271.11	< .001
Disturbingness	Disturbingness	0.004	0.001	[0.002, 0.006]	133	3.778	< .001
Movement	Avoid - Approach	0.005	0.01	[-0.014, 0.024]	214	0.512	0.609
Disturbingness × Movement	Disturbingness × Avoid - Approach	-0.003	0.002	[-0.006, 6.96e-4]	14766	-1.568	0.117

Table 4

Simple Effects of Disturbingness: Parameter Estimates (Hypothesis 2)

Movement	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
Approach	0.005	0.001	[0.00259, 0.008]	405	3.89	< .001
Avoid	0.002	0.001	[-2.08e−4, 0.005]	408	1.81	0.071

3.2.4. Additional Analyses

When gaming score, trial, order, instruction, their 3-way interactions with disturbingness and movement, and corresponding lower order 2-way interactions were added to the main model, there were significant effects of gaming score ($F(1, 210) = 31.281$, $p < .001$) and its interaction with disturbingness ($F(1, 16050) = 6.902$, $p = .009$) (in addition to a significant effect of disturbingness). Responses got faster as gaming score increased. When study, gender, age, gaming score, their 3-way interactions with disturbingness and movement, and corresponding lower order 2-way interactions were added to the main model, there were no significant effects other than disturbingness, gaming score, and their interaction. In a model with only disturbingness, gaming score, and their interaction, there was not a significant interaction, but simple effects analysis showed that effect of disturbingness got weaker as gaming score increased (see Table 5).

Table 5

Simple Effects of Disturbingness: Parameter Estimates (Hypothesis 2)

Gaming Score	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
Mean - 1 SD	0.006	0.001	[0.003, 0.008]	375	4.504	< .001
Mean	0.003	0.001	[0.001, 0.005]	130	3.315	0.001
Mean + 1 SD	0.001	0.002	[-0.002, 0.004]	510	0.667	0.505

3.3. Hypothesis 3

It was expected that response times increase for approaching contamination pictures compared to neutral pictures and decrease for avoiding contamination pictures compared to neutral pictures, as VOCI-Contamination scores increase (3-way interaction between VOCI-Contamination, picture type, and movement).

3.3.1. Comparison of Models with Different Transformations

Our model included the fixed effects of picture type, movement, VOCI-Contamination, their 2-way and the 3-way interactions as well as random intercepts, participant random slope for picture type, participant random slope for movement, and picture random slope for movement. We compared models with “ln” and “inverse” transformations of response time (see Figure 6). In terms of normality, there was not a visible difference. In terms of homoskedasticity, the model with the ln transformation seemed worse because the residuals were smaller (showed less variance) for smaller predicted values in the model. Thus, we did the subsequent analyses with inverse response time as the dependent variable.

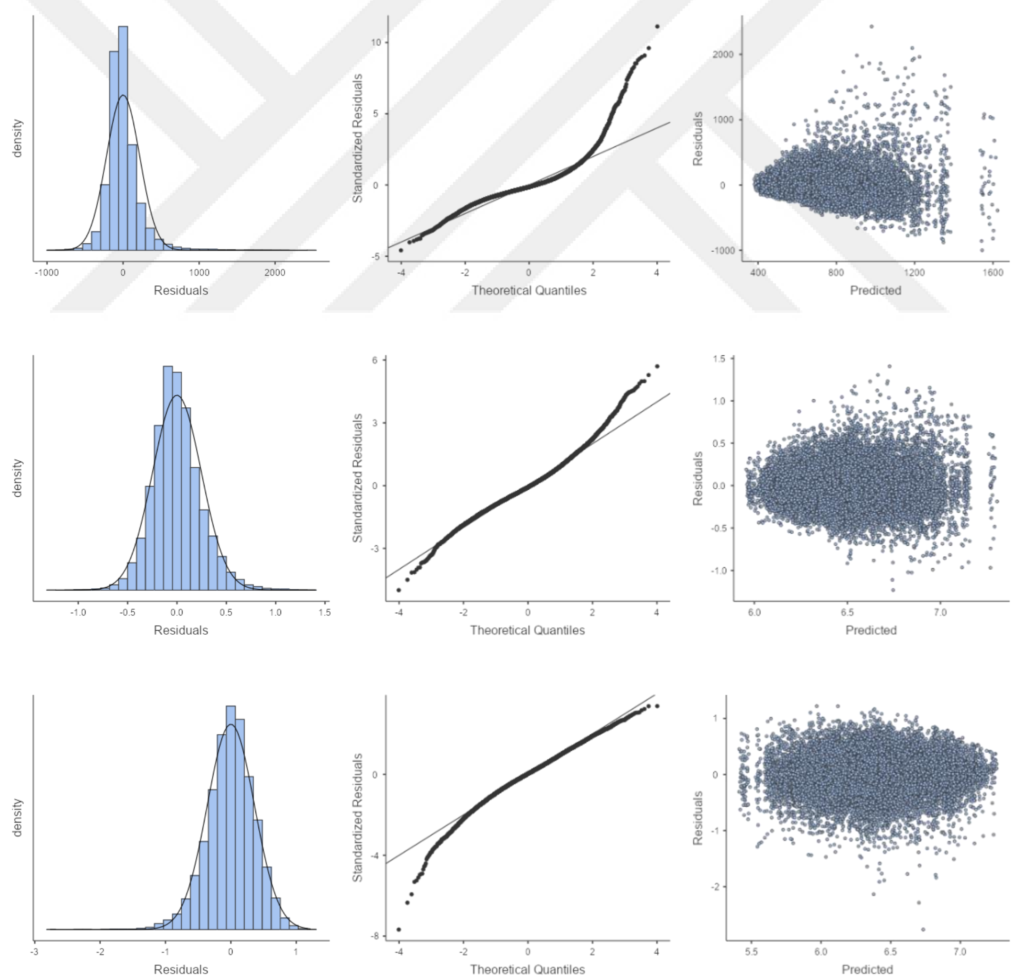

Figure 8. Residual Histograms, Q-Q Plots, and Residual Scatterplots (from Left to Right) of Raw Response Time, Ln Response Time, and Inverse Response Time (from Top to Bottom) for Hypothesis 3.

3.3.2. Comparison of Models with Different Random Effects

Since the correlation between picture random slope for movement and picture random intercept was 1, we excluded the picture random slope for movement to see whether the model improved. The model with the picture random slope for movement (AIC: 14692.81, BIC: 14905.221) was worse than the model without it (AIC: 14688.814, BIC: 14885.816) so we chose the model without the picture random slope for movement for the main analysis. The residuals of the random effects were not normally distributed (see Figure 9).

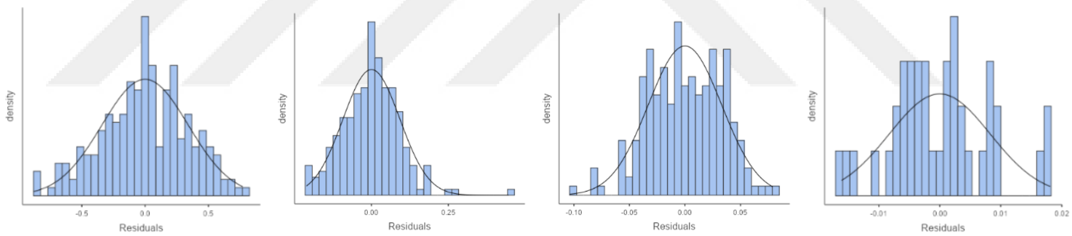

Figure 9. Residual Histograms of Participant Random Intercept, Participant Random Slope for Movement, Participant Random Slope for Picture Type, and Picture Random Intercept (from Left to Right) for Hypothesis 3.

3.3.3. Main Analysis

There was only a significant effect of picture type: contamination pictures caused slower responses (see Table 6). Thus, results did not support the Hypothesis 3. Simple effects analysis showed that the simple main effect of picture type was significant for the approach movement but not for the avoid movement, and the effect of picture type was stronger for approach movement (see Table 7).

Table 6

Fixed Effects Parameter Estimates for Hypothesis 3

Names	**Effect**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
(Intercept)	(Intercept)	6.418	0.024	[6.371, 6.464]	216.0	269.823	< .001
Picture Type	Contamination - Neutral	0.022	0.008	[0.007, 0.038]	48.6	2.852	0.006
Movement	Avoid - Approach	0.005	0.01	[-0.014, 0.024]	212.6	0.504	0.615
VOCI	VOCI	-6.29e−4	0.003	[-0.006, 0.005]	212.9	-0.223	0.824
Picture Type × Movement	Contamination - Neutral × Avoid - Approach	-0.026	0.011	[-0.048, -0.003]	15739.2	-2.245	0.025
Picture Type × VOCI	Contamination - Neutral × VOCI	8.13e-4	7.77e -4	[-7.11e −4, 0.002]	210.6	1.046	0.297

Movement × VOCI	Avoid - Approach × VOCI	0.001	0.001	[-8.12e −4, 0.004]	211.2	1.254	0.211
Picture Type × Movement × VOCI	Contamination - Neutral ×Avoid - Approach × VOCI	-0.002	0.001	[-0.005, 7.39e-4]	15737.3	-1.413	0.158

Table 7

Simple Effects of Picture Type: Parameter Estimates (Hypothesis 3)

Movement	**Contrast**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
Approach	Contamination - Neutral	0.035	0.01	[0.016, 0.054]	113	3.625	< .001
Avoid	Contamination - Neutral	0.01	0.01	[-0.01, 0.029]	113	0.994	0.322

3.3.4. Additional Analyses

When FCV-19S, DASS-Depression, DASS-Anxiety, DASS-Stress, gaming score, their 3-way interactions with picture type and movement, and corresponding lower order 2-way interactions were added to the main model, there was only a significant effect of gaming score, $F(1, 208) = 19.678$, $p < .001$ (in addition to the significant effect of picture type). Responses got faster as gaming score increased. When trial, order, instruction, study, gender, age, gaming score, their 3-way interactions with picture type and movement, and corresponding lower order 2-way interactions were added to the main model, there were no significant effects other than gaming score and picture type. In a model with picture type, gaming score, and their interaction, there was not a significant interaction, but simple effects analysis showed that effect of picture type got weaker as gaming score increased (see Table 8).

Table 8

Simple Effects of Picture Type: Parameter Estimates (Hypothesis 3)

Gaming Score	**Contrast**	**Estimate**	**SE**	**95% CI**	**df**	**t**	**p**
Mean – 1 SD	Contamination - Neutral	0.026	0.01	[0.006, 0.046]	104	2.54	0.013
Mean	Contamination - Neutral	0.023	0.008	[0.007, 0.038]	47.6	2.89	0.006
Mean + 1 SD	Contamination - Neutral	0.019	0.01	[-0.001, 0.039]	104	1.88	0.063

3.4. Hypothesis 4

Accuracy of responses is related to disturbingness and movement.

3.4.1. Comparison of Models with Different Random Effects

We started the model with the fixed effects of disturbingness, movement, and their interaction as well as random intercepts, picture random slope for movement, and participant random slope for movement. The correlations between random intercepts and corresponding random slopes for movement were 1, so we excluded random slopes one by one to see whether the model improved, and it improved every time we excluded a random slope (AIC's: 3022.58, 3018.6, 3017.1; BIC's: 3099.822, 3080.392, 3063.441) so we chose the model with random intercepts only.

3.4.2. Main Analysis

There was only a significant effect of movement (see Table 7). Probability that a response is accurate was .985 (95% CI [.981, .988]) for approach movement and .989 (95% CI [.986, .991]) for avoid movement. Thus, the effect of movement was very small.

Table 9

Fixed Effects Parameter Estimates for Hypothesis 4

Names	**Effect**	**Estimate**	**SE**	**exp(B)**	**95% CI**	**z**	**p**
(Intercept)	(Intercept)	4.325	0.108	75.58	[61.198, 93.34]	40.16	< .001
Movement	Avoid - Approach	0.311	0.118	1.365	[1.084, 1.72]	2.65	0.008
Disturbingness	Disturbingness	-0.029	0.02	0.972	[0.936, 1.01]	-1.49	0.135
Movement × Disturbingness	Avoid - Approach × Disturbingness	-0.042	0.034	0.959	[0.898, 1.02]	-1.24	0.216

3.5. Hypothesis 5

Accuracy of responses is related to picture type, movement, and VOCI-Contamination.

3.5.1. Comparison of Models with Different Random Effects

We started the model with the fixed effects of picture type, movement, VOCI-Contamination, their 2-way interactions, and their 3-way interaction as well as random intercepts, participant random slope for picture type, participant random slope for movement, and picture random slope for movement. The correlation between picture random intercept and picture random slope for movement was 1. When we excluded the random slope, the model improved (AIC: 3035.23 to 3031.28, BIC: 3166.537 to 3147.138). In the new model, the correlation between the participant random intercept and the participant random slope for movement was .708. When we excluded the random slope, model improved (AIC: 3031.28 to 3027.99, BIC: 3147.138 to 3120.676). In the new model, the correlation between the participant random intercept and the participant random slope for picture type was 1. When we excluded the random slope, the model improved further (AIC: 3027.99 to 3024.8, BIC: 3120.676 to 3102.038). Thus, we chose the model with random intercepts only.

3.5.2. Main Analysis

There was only a significant effect of movement (see Table 8). Probability that a response is accurate was .985 (95% CI [.981, .988]) for approach movement and .989 (95% CI [.986, .991]) for avoid movement. Thus, the effect of movement was very small.

Table 10

Fixed Effects Parameter Estimates for Hypothesis 5

Names	**Effect**	**Estimate**	**SE**	**exp(B)**	**95% CI**	**z**	**p**
(Intercept)	(Intercept)	4.326	0.107	75.64	[61.269, 93.38]	40.2372	< .001
Picture Type	Contamination - Neutral	-0.008	0.135	0.992	[0.761, 1.29]	-0.0556	0.956
Movement	Avoid - Approach	0.306	0.118	1.358	[1.078, 1.71]	2.6004	0.009
VOCI	VOCI	0.003	0.01	1.003	[0.983, 1.02]	0.3149	0.753
Picture Type × Movement	Contamination - Neutral × Avoid - Approach	-0.269	0.236	0.764	[0.481, 1.21]	-1.1427	0.253
Picture Type × VOCI	Contamination - Neutral × VOCI	-0.022	0.015	0.978	[0.950, 1.01]	-1.4641	0.143
Movement × VOCI	Avoid - Approach × VOCI	0.001	0.015	1.001	[0.972, 1.03]	0.0812	0.935
Picture Type × VOCI × Movement	Contamination - Neutral × Avoid - Approach × VOCI	-0.021	0.03	0.979	[0.923, 1.04]	-0.6884	0.491

CHAPTER 4

DISCUSSION

4.1. Summary of the Results

With Hypothesis 1, we expected that as people's contamination symptom scores increase, they find contamination pictures (but not neutral pictures) more disturbing. Results supported the Hypothesis 1: Even though contamination pictures were reported as more disturbing than neutral pictures in general, contamination pictures (but not neutral pictures) were reported as even more disturbing, as people's contamination symptoms increased.

With Hypothesis 2, we expected that more disturbing pictures would induce a stronger automatic avoidance tendency. Specifically, we expected slower responses for approaching more disturbing pictures, and faster responses for avoiding them. Results did not support the hypothesis 2: More disturbing pictures caused slower responses, but approach-avoidance movement did not significantly moderate this picture effect.

With Hypothesis 3, we expected that contamination pictures would induce a stronger automatic avoidance tendency for people who have more contamination symptoms. Specifically, we expected that as people's contamination symptom scores increase, their responses would become slower for approaching contamination pictures (compared to neutral pictures), and faster for avoiding them. Results did not support Hypothesis 3: Contamination pictures yielded slower responses; but approach-avoidance movement, contamination symptoms, or their interaction did not significantly moderate this picture effect.

With Hypothesis 4, we examined whether accuracy of responses is affected by how disturbing the pictures are and approach-avoidance movement. With Hypothesis 5, we examined whether accuracy of responses is affected by picture type (neutral vs. contamination), movement, and contamination symptoms. Analyses of accuracy showed that avoiding pictures increased the possibility of error very slightly, compared to approaching pictures, regardless of the picture type (or how disturbing the picture was).

4.2. Interpretation of the Results

Since contamination pictures were reported as more disturbing as people's contamination symptoms increased, we can conclude that both the VOCI-Contamination subscale and picture sets we created were reliable instruments. If this was not the case, assessment of automatic avoidance tendency from contamination-related stimuli would be meaningless because the assessment relies on these instruments. By confirming the specific effect of contamination pictures on people with more contamination symptoms, we could further investigate whether contamination pictures induce stronger automatic avoidance tendencies as contamination symptoms increase. Thus, lack of evidence for automatic avoidance tendency in our study has two possible explanations: Either the avoidance tendency from contamination-related stimuli is not that automatic, or our approach-avoidance task is not successful at detecting this automatic avoidance tendency.

In addition to investigating automatic avoidance tendency in relation to how disturbing the pictures are (Hypothesis 2), we also investigated the role of contamination symptoms in automatic avoidance tendency from contamination pictures (Hypothesis 3). The Hypothesis 2 neither took contamination symptoms into account nor categorized the pictures as contamination and neutral, so it was a bottom-up and generic hypothesis which was based on the automatic avoidance tendency from disturbing pictures in general. For instance, if a participant found a neutral picture disturbing for some reason (e.g. a participant who is afraid of swing sets), it was expected that (and tested whether) there would be an automatic avoidance tendency from that picture, too. The Hypothesis 3, on the other hand, had contamination pictures and neutral pictures as distinct categories and contamination symptoms as the moderator, so it was a top-down and specific hypothesis which was based on the automatic avoidance tendency from contamination pictures. It could be argued that Hypothesis 2 was more likely to be supported since it was not based on a priori categorization of pictures (contamination vs. neutral) or a questionnaire assessing a specific construct (i.e. contamination symptoms), but based on the explicit evaluations of pictures (i.e. how disturbing the pictures were) – which may be a better predictor of automatic avoidance tendency.

Using picture type as a dichotomous variable and using how disturbing pictures are as a continuous variable produced the same picture effects on response time: Contamination (or more disturbing) pictures caused slower responses. This finding may be due to the fast component of emotional Stroop effect (McKenna & Sharma, 2004) since movement did not significantly moderate the picture effects. However, approaching contamination (or more disturbing) pictures was slightly slower than avoiding them. In addition, even though there was no significant interaction between picture type (or disturbingness) and movement in the main analyses, simple effects analyses showed that approaching contamination (or more disturbing) pictures was significantly slower, while avoiding them was non-significantly slower. Thus, the automatic avoidance tendency may have been stronger for approaching contamination (or more disturbing) pictures than avoiding them. In other words, approaching contamination (or more disturbing) pictures may have been harder, but avoiding them may have not been easier. Since approaching a negative stimulus is punished while avoiding it is negatively reinforced (Najmi et al., 2010), and the effect of punishment may be stronger than the effect of reinforcement, response time may be a more sensitive indicator for approach movement than avoidance movement. In addition, the effect of automatic avoidance tendency in avoidance movement [i.e. faster responses for contamination (or more disturbing) pictures] may have been engulfed by the emotional Stroop effect [i.e. slower responses for contamination (or more disturbing) pictures]. In summary, the differential picture effects for approach movement and avoidance movement may be due to the additive effects of an emotional Stroop and a stronger automatic avoidance tendency for approach movement in contrast to the subtractive effects of an emotional Stroop and a weaker automatic avoidance tendency for avoidance movement.

There was another consistent finding in response time analyses: Responses got faster as people’s gaming scores increased. In addition, even though there was not a significant interaction between gaming score and picture type (or disturbingness), simple effects analyses suggested that picture effects got weaker as gaming scores increased. This may have been due to the faster responses of more experienced gamers which did not allow the effects of pictures (e.g. emotional

Stroop effect and/or automatic avoidance tendency) to operate fully. In addition, more experienced gamers may have been more focused on their task, i.e. responding based on the color of picture frames, so they may have paid less attention to the picture contents, and processed them less deeply.

4.3. Comparison with Other Studies

In our study, contamination pictures (or more disturbing pictures) caused slower responses in general. This picture effect was not present in previous studies on automatic avoidance tendency from contamination-related stimuli (Najmi et al., 2010; Amir et al., 2013; Cludius et al., 2017) or the online-VAAST study (Aube et al., 2019). This discrepancy between our study and previous studies on automatic avoidance tendency from contamination-related stimuli may be due to the fact that we used the (modified) online-VAAST rather than the AAT. In addition, we used more pictures, which may have increased the sensitivity of our task, considering the heterogeneity of contamination-related stimuli. The discrepancy between our study and the online-VAAST study may be due to the amplified visual feedbacks we used. Approaching negative pictures may be even harder/slower with this modification, so the response time difference between picture types may have increased. Lastly, we used more practice trials than all of the other studies, so the performance on main trials may have become more stable with less confounding effects (e.g. slower responses at early trials), which may have made the picture effect more evident.

In our study, movement did not significantly moderate the effect of picture type (or disturbingness). Among the previous studies on automatic avoidance tendency from contamination-related stimuli, only one study (Cludius et al., 2017) used movement as a variable (the other two studies conducted separate analyses for approach and avoidance movements). As in our study, movement did not significantly moderate the effect of picture type in Cludius et al.'s (2017) study. Contradicting our findings, there was a significant interaction between picture type and movement in the online-VAAST study: Approaching negative pictures and avoiding positive pictures yielded slower responses than approaching positive pictures and avoiding negative pictures. The discrepancy between our study and the online-VAAST study may be due to the fact that we used implicit response criteria (moving based on frame color) whereas they used explicit response criteria (moving based on the valence of the picture). Explicit response criteria made participants think about the picture content and increased the exposure time for the pictures, both of which can strengthen the avoidance tendency. With implicit response criteria, we investigated a higher degree of automaticity, so it is possible that the avoidance tendency from contamination-related stimuli is not that automatic. In addition, with explicit response criteria, participants may have predicted the research hypothesis, so a demand effect may have occurred in the online-VAAST study. Another fundamental difference between our study and the online-VAAST study is that we used neutral pictures, while the online-VAAST study used positive pictures. Consequently, the compatibility effect reported in the online-VAAST study incorporated both approach and avoidance tendencies, whereas we only measured the avoidance tendency. Thus, we presumably were trying to detect a smaller effect than the online-VAAST study was.

In our study, contamination symptoms did not significantly moderate the effect of picture type, which is consistent with Amir et al.'s (2013) study in which there was not a significant response time difference between contamination and neutral pictures, for people with more severe contamination symptoms (2 SD above the mean of the normal population). Najmi et al.'s (2010) study, on the other hand, found that people with more contamination symptoms (upper half of the sample after the median split) had slower responses for contamination pictures, compared to neutral pictures, in the analysis of approach (but not avoidance) movement. Similarly, Cludius et al.'s (2017) study found that OCD patients had slower responses for contamination stimuli, compared to neutral stimuli. The discrepancy between our study and these latter two studies may be due to the fact that these studies used participants' average scores for each picture type in their analyses, since this procedure is known to inflate type I error (Judd et al., 2012). Alternatively, since our study was conducted online, there may have been confounds over which we had no control. The discrepancy between our study and Cludius et al.'s (2017) study may be also due to their recruitment of OCD patients, who may have stronger automatic avoidance tendencies from contamination-related stimuli.

4.4. Limitations of the Study

Since the study was conducted online, we could not control the environments of participants. Considering the ongoing partial lockdown (due to the Covid-19 pandemic) during the study, some participants' performance on the task may have been influenced by unwanted factors (e.g. distractions due to other people in the house). However, we could not use a lab due to the lockdown, so we did not have any other option than conducting the study online. In addition, psychological effects of the lockdown may have affected people's performance on the task. We assessed fear of Covid-19 as well as depression, anxiety, and stress levels of participants but there may have been other effects of lockdown on task performance, which we did not take into account (e.g. increased irritability due to the lockdown).

We excluded response times above 4000 ms and above 2.5 SD for each condition for each participant. However, there were still very slow responses compared to average responses. Those responses may have been the result of picture effects which we did not investigate in this study (e.g. freezing after seeing a very disturbing picture). Possibly, including such very slow responses may have inhibited us detecting "slightly slower" responses for certain conditions which we were interested in. Thus, the effect of automatic avoidance tendency in which we were interested may have been obscured by other effects occurring in the task.

4.5. Future Research

We modified the online-VAAST and used it in a new context, namely, with contamination vs. neutral pictures rather than positive vs. negative pictures. In addition, we used implicit response criteria, rather than explicit response criteria as in the online-VAAST studies. Even though we did not find sufficient evidence for automatic avoidance tendency from contamination pictures, our modified version of the online-VAAST may be used with positive vs. negative pictures in order to try finding the compatibility effect which was shown in the online-VAAST studies. Thus, it can be investigated whether this effect occurs with the implicit response criteria, too. If the compatibility effect can be observed with positive vs. negative stimuli, positive vs. neutral and negative vs. neutral stimuli can be used in order to investigate automatic approach and avoidance tendencies separately.

Alternatively, contamination vs. neutral pictures may be used with explicit response criteria. This design would allow researchers to investigate a lesser degree of automaticity in terms of avoidance tendency from contamination-related stimuli. Thus, if a study with explicit response criteria can find evidence for automatic avoidance tendency, and replications of our study with implicit response criteria cannot, then we can more confidently conclude that avoidance tendency from contamination-related stimuli is not that automatic. In addition, other studies can recruit people with actual diagnoses in order to investigate stronger approach-avoidance tendencies. For instance, a study may be conducted comparing OCD patients to healthy and clinical control groups.

If future studies can show that (modified) online-VAAST is an effective tool for assessing automatic approach-avoidance tendencies, this tool can be used in various domains. Popularizing the online-VAAST would be beneficial, since it has the considerable practical advantages of being an online tool. Researchers may conduct studies with large samples with minimal effort and resources (even during a lockdown), and replication or collaborative studies would be much easier. In addition, it may be possible to modify automatic approach-avoidance tendencies using a training variant of the online-VAAST, since it was shown that re-training via AAT reduced the automatic avoidance tendency from contamination-related stimuli (Amir et al., 2013). By this, people who consistently approached contamination stimuli in re-training for a while responded faster when approaching contamination stimuli, compared to people who were not in re-training. Such re-training is also called cognitive bias modification (CBM) since participants execute certain responses in order to change the previous predisposition towards other responses (Koster, Fox, & MacLeod, 2009). If its effectiveness is established, the online-VAAST may be used as a CBM tool, in which negative stimuli are voluntarily approached in order to eliminate the avoidance tendency.

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APPENDICES