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Evaluating the Effect of Approach-avoidance Training on Action Tendencies for Individuals with Skin Picking Disorder

Abel Steven Mathew
University of Wisconsin-Milwaukee

EVALUATING THE EFFECT OF APPROACH-AVOIDANCE TRAINING ON ACTION TENDENCIES FOR INDIVIDUALS WITH SKIN PICKING DISORDER

by

Abel S. Mathew

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ABSTRACT

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Abel S. Mathew

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Pathological skin picking (PSP) or excoriation disorder is a destructive behavior that affects 1-2% of the general population. The purpose of this pilot study was to evaluate the effect of a computerized behavior modification task on action tendencies (i.e., approach or avoidance) in adults with PSP. We aimed to reduce these action tendencies by having participants with PSP complete the Approach-Avoidance Training (AAT) task. Thirty-two participants with PSP were placed in one of three training conditions: (1) Avoidance Training (AvT) (2) Approach Training (ApT) (3) Placebo Training (PT). Using a joystick to simulate an approach (=pull) or avoidance (=push) response, we hypothesized that after training those in the AvT would have the greatest reduction in behavioral approach (i.e., their overall reaction time (RT) to approach pictures of irregular skin stimuli). Results of the pre-assessment task revealed a positive correlation between behavioral approach to irregular skin stimuli and skin picking severity reported on the Skin Picking Scale-Revised (SPS-R). After training, a *decrease* in behavioral approach and urges to pick were found in the AvT and PT groups, while those in the ApT reported an *increase* in behavioral approach and urges. After two-week follow up, no significant changes on the SPS-R were reported between groups. Our preliminary data suggest that the AAT is a promising avenue of research to develop as a cognitive intervention to address an excessive behavioral approach tendency that characterizes skin picking problems.

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Introduction

Pathological Skin Picking

Excoriation disorder, also known as pathological skin picking (PSP) or dermatillomania, is a destructive behavior that affects 1-2% of the population sharing similarities to a larger cluster of disorders known as body focused repetitive behaviors (BFRBs) (Odlaug & Grant, 2008). The onset of PSP occurs during adolescence, predominantly affecting women of lower income (Arnold, McElroy, Mutasim, Dwight, Lamerson, & Morris, 1998). To be formally diagnosed with PSP in the DSM-5, individuals must endorse all of the following: (a) recurrent skin picking resulting in skin lesions (b) repeated attempts to decrease or stop skin picking (c) resulting distress or impairment (d) symptoms not accounted for by a medical condition or other psychiatric disorder (American Psychiatric Association, 2013; APA, 2013). While BFRBs may be perceived as harmless to many, severe clinical presentations caused by repetitive picking, pulling, or biting leads to destruction of the sites. Indeed, severe cases of skin picking consequently result in open sores, wounds, and infection that may require medical attention for commonly picked areas such as the face, arms, and hands (Grant, Odlaug, Chamberlain, Keuthen, Lochner, & Stein, 2012). Thus, the resulting damage these behaviors inflict on PSP individuals may cause them to be more susceptible to instances of embarrassment or avoidance of public settings resulting in psychosocial impairment (Flessner & Woods, 2006). The disorder falls in the obsessive-compulsive spectrum, where emphasis on the compulsion resonates with skin picking behaviors (APA, 2013). In addition, individuals may or may not be aware that they are engaging in the behavior (i.e. focused vs. automatic picking) (Walther, Flessner, Conelea, & Woods, 2009). Indeed, a majority of those with PSP admit to spending at least one hour per day intentionally or unintentionally picking, thinking about picking, or resisting urges (APA, 2013).

PSP as a Behavioral Addiction

Though the etiology of PSP and other BFRBs is unclear, there exists some evidence that there is a higher risk of developing a BFRB such as PSP among individuals with OCD or their first-degree family member (APA, 2013). Furthermore, researchers have gained a deeper understanding of these maladaptive coping mechanisms through such areas as impulse control and emotion regulation (Diefenbach, Tolin, Meunier, & Worhunsky, 2008; Shusterman, Feld, Baer, & Keuthen, 2009; Roberts, O'Connor, & Belanger, 2013; Snorrason, Smári, & Ólafsson, 2010). For example, according to the associated features for PSP in the DSM-5, the individual may feel extreme anxiety or tension before picking their skin and receive gratification after completion, ultimately attenuating their anxiety levels (Diefenbach et al., 2008; Swedo & Leonard, 1992). Thus, the individual may repetitively skin pick to achieve these feelings to the point where the behavior becomes addictive. The conceptualization of PSP as a behavioral addiction is comprised of the following core components as described by Odlaug and colleagues: (a) repetitive or compulsive engagement in the behavior despite adverse consequences (b) diminished control over the problematic behavior (c) an appetitive urge or craving state prior to engagement in the problematic behavior (d) pleasant sensations during the performance of the problematic behavior (Odlaug et al., 2008; Grant, Potenza, Weinstein, & Gorelick, 2010). If the participant is not willing to counter these biases, the addictive behavior will continue (Wiers et al., 2007). While successful treatment for addressing this disorder has been found through such avenues as behavior therapy including habit reversal training or acceptance-enhanced behavior therapy (Grant et al., 2012; Deckersbach, Wilhelm, Keuthen, Baer, & Jenike, 2002), treatment can become expensive, and it may not be available, especially for individuals from rural areas.

Thus, a mobilized training that can be utilized as an additive tool for therapy to ensure cost efficiency, and successful treatment outcome would be useful.

The Approach Avoidance Training (AAT) Task

The conceptualization of PSP as a behavioral addiction suggests that a cognitive behavior modification focused on manipulating action tendencies (i.e., approach or avoidance) may prove to be a potentially useful intervention. Behavioral addictions are often characterized by pathological approach tendencies toward the stimuli (e.g. failure to stop picking due to pleasure or urges despite harmful consequences; Odlaug, Chamberlain, & Grant, 2010). An approach tendency is defined as what the individual is physiologically and cognitively primed to do (Lowe & Zienke, 2011). For example, a problematic alcohol user will have an approach tendency to drink alcohol when entering a bar because he/she is physiologically addicted to alcohol. In contrast, an individual with arachnophobia (the fear of spiders) will have an avoidance tendency to enter an old building with lots of cobwebs because a spider may be present. Thus, the individual is primed to distance him or herself from the perceived danger. The Approach-Avoidance Training (AAT) is an area of research that has shown promise in the treatment of alcohol and phobias, but has yet to be explored as a potential intervention for BFRBs.

This cognitive bias modification (CBM) task can retrain an individual's approach or avoidance tendencies in response to target stimuli, using a game-like technique where the participant either pulls (=approach) or pushes (=avoid) a joystick based on the stimuli presented on the computer screen. To evaluate one's level of approach or avoidance, reaction time (RT) is determined for each trial. RT is the amount of time it takes to respond to a specific stimulus. For example, if the average RT to pull the joystick (=approach) is quicker than pushing the joystick (=avoid), this indicates an approach action tendency.

To further emphasize the approach/avoidance behavior, the training employs a zooming effect (Rinck & Becker, 2007). Specifically, pushing the joystick away causes the picture on the screen to shrink (=avoidance), while pulling the joystick towards oneself causes the picture to expand (=approach). This push-pull paradigm is in response to the individual's inherent action tendencies (Figure 1). The AAT can function as both an assessment tool, and training program in which a rule will be implemented. For example, the rule may include pulling when the picture presented is in portrait mode and pushing when the picture is in landscape mode. As an assessment tool, the AAT can determine an individual's underlying approach/avoidance tendencies through the measurement of RT. Participants will approach and avoid the target and control stimuli an equal amount of times, unlike the training condition. After evaluating the participant's RT, the experimenter can determine the participant's action tendencies toward the presenting stimuli.

The AAT can also be used as a training program. The purpose of the training is to modify the participant's action tendencies. Using the same procedure in the assessment task, the participant is given a rule to follow in which he/she will approach or avoid the target and control stimuli. However, instead of approaching and avoiding the target an equal amount of times, the participant is trained to primarily/entirely approach (or avoid) the target stimulus depending on the training condition the participant is placed in. With successful training, participants are expected to display modified action tendencies.

As mentioned earlier, PSP can be conceptualized as a behavioral addiction. The precursors to the behavior include anxiety or tension, leading to picking at the skin, resulting in guilt, shame, and potential destruction at the site. This maladaptive coping mechanism occurs in a cyclical manner, despite its harmful consequences, thus maintaining the addictive behavior.

The push-pull paradigm of the AAT can potentially function as a means of behaviorally modifying these inherent action tendencies within the individual. Successful implementation of the training for skin picking is expected to diminish the approach tendency towards skin.

Reflective-Impulsive Model: The Theory Behind AAT

The AAT idea was based upon the works of Solarz (1960) where he used valenced (i.e. positive or negative) word cards to move toward or away from the participant. His findings revealed that positively valenced words facilitate approach behaviors while negatively valenced words facilitate avoidance behavior (Solarz, 1960). This suggests that affective stimuli automatically activate corresponding action tendencies. However, the mechanism behind this phenomenon was unclear. Strack and Deutsch (2004) used their reflective-impulsive model to explain the phenomena of positive and negative valences and its correlation to approach and avoidance behaviors. The reflective-impulsive model is split into two parts: (a) the reflective or rule based system which is the result of deliberate decisions derived from rational knowledge processing and (b) the impulsive system where the behavioral schema is activated between associated nodes of information (Strack & Deutsch, 2004). The activation of these behaviors is moderated by motivational orientations. Motivational orientations are action tendencies to approach attractive stimuli and avoid dangerous stimuli. These action tendencies are developed by one's perceptions of the stimuli in the environment. Therefore, if one is trained to approach or avoid certain stimuli, it can influence their corresponding motivational orientations.

Approach orientation is one's preparedness to decrease distance from particular stimuli while avoidance is to increase distance from the stimuli. Thus, individuals are slower to approach aversive pictures and faster to avoid pictures they deem desirable, compared to approaching or avoiding neutral pictures. At least two features of PSP render evaluation of particularly

interesting implicit processes. First, individuals with PSP often report impulsivity or an inability to control the urge to engage in picking behavior (Odlaug et al., 2010). Second, skin-picking behavior is often reported to occur automatically or unconsciously (Arnold et al., 1998; Walther et al., 2009). Therefore, the employment of indirect trainings, like the AAT, to identify implicit processes appears promising towards an extended understanding of the mechanisms involved in the execution of PSP.

Existing AAT Research

As noted earlier, previous research has looked at this approach-avoidance paradigm in substance abuse, in which disproportionate approach toward alcohol is a core problem. A randomized experiment by Wiers and colleagues (2010) on a sample of alcohol-dependent patients aimed to determine whether action tendencies toward alcohol related cues could be lessened by the AAT (Wiers et al., 2010). Patients (N=214) were shown pictures of 20-alcoholic (target stimulus) and 20 non-alcoholic soft drinks (control stimulus). There were two different training conditions: active AAT and sham AAT. Participants were instructed to approach or avoid stimuli by implicitly following a rule based on picture format (i.e., portrait vs. landscape). For the active AAT group, pictures of alcohol were always presented with a rule that required pushing (= avoidance), whereas pictures of soft drinks were always presented with a rule that required pulling (= approach). In contrast, for the sham AAT group, pictures of alcohol and soft drinks were presented in a balanced way such that participants pulled or pushed both stimulus categories an equal number of times. The results were tested based on Time (pretest or posttest) x Drink type (alcohol or soda) x Training condition (active or sham). The active AAT group displayed a slight tendency to approach alcohol pictures at pre-training, but demonstrated a strong avoidance tendency at post-training (in line with the direction of their AAT training

designed to have them practice avoiding pictures of alcohol). Further analyses also revealed that subjective craving for alcoholic beverages decreased in the training group, but remained unchanged in the control group. In addition, at one-year follow-up, clinical outcomes were obtained for 86% of the patients, of which 46% of the experimental group had relapsed (50 of 108 patients). In sum, the AAT training successfully retrained these individuals to avoid pictures of alcoholic beverages and approach pictures of soft drinks, which significantly reduced drinking (or alcohol-approach) behavior (Wiers et al., 2010).

Despite the significant results from Wiers and colleagues (2010), the study has important methodological limitations. For example, the experiment aimed to decrease alcohol approach tendencies by having participants approach non-alcoholic soft drinks within the same training. The soft drinks were used as a substitute for alcohol in the training, though it can be argued that soft drinks are equally unhealthy (i.e., high levels of sugar, corn syrup, caffeine). In addition, soft drinks were approached 100% of the time, and alcoholic stimuli were avoided 100% of the time. Thus, while modifying the participants' action tendencies to avoid alcohol, the AAT also increased the participants' approach tendencies to soft drinks. In theory, this could result in a higher affinity for soft drink beverages, which could potentially contribute to other unassessed health problems (diabetes, obesity, high blood pressure). Further, due to this study design, it is unclear whether the training outcomes (e.g., reduced craving for alcohol and lower relapse rates) resulted from avoiding alcohol or approaching soda, which significantly attenuated the internal validity of the investigation. To address these methodological issues, our pilot study will use a control stimulus that is neutral, which will also be approached and avoided an equal amount of times (50%) so that the participant does not develop a particular action tendency towards the control stimulus.

A study more relevant for understanding PSP is one implemented by Schuck and colleagues (2012), which administered a single AAT assessment, using individuals with PSP (n=34) and healthy controls (n=47). In this study, participants consisted of three groups: (1) Individuals with PSP who completed the AAT task prior to receiving cognitive behavior treatment (PSP-CBT), (2) Individuals with PSP who completed the AAT task without subsequent CBT (i.e., no treatment; PSP-NT), and (3) healthy controls who completed the AAT task. Compared to healthy controls, both PSP groups displayed a stronger *avoidance* of pictures of skin irregularities, which significantly correlated with higher skin picking severity. In addition, for the PSP-CBT group, stronger avoidance of pictures of skin irregularities on the AAT task was associated with better CBT treatment outcome.

These findings include somewhat contradictory data difficult to interpret. First of all, PSP may be characterized by the avoidance tendency on the AAT task in response to pictures of irregular skin, which was positively correlated with picking severity. Thus, such avoidance appears to be a pathological behavioral tendency. In contrast, such avoidance tendencies predicted better CBT treatment outcomes (as a potentially positive prognostic factor). Further research is needed to clarify these findings. Schuck and colleagues (2012) do not clearly indicate the ideal direction of AAT training for PSP. They may propose that participants should be trained to approach skin pictures to reduce the pathological tendency of avoidance (which is associated with symptom severity). They could also propose that participants should be trained to avoid because it might be a prognostic indicator especially in the context of using AAT as an adjunctive intervention for CBT.

In addition, the AAT for skin picking has methodological limitations that should be considered. First, it is unclear how AAT response changes after treatment. Although the pre-CBT

AAT pattern in PSP patients was avoidance, we are not sure how their action tendencies would have changed post-CBT (e.g., more avoidance or approach). Second, individuals with PSP were not asked specifically which areas of skin they pick at the most. Instead, they were shown pictures of multiple skin areas that may not have been as personally relevant, and thus potentially failed to reveal their true underlying action tendencies. Third, study entry criteria were too narrow with the inclusion of actual skin damage. Participants included in the study were required to have tissue damage as a result of repetitive skin picking, and individuals with a dermatological condition (e.g., eczema) were still included. Therefore, it is not clear whether their findings would be replicated among individuals displaying mild to moderate levels of PSP without actual skin damage or dermatological complications. Fourth, this study only included participants with PSP who were motivated to undergo CBT. The reason for the stronger avoidance tendency among PSP participants over healthy controls may be a result of their personal wish to reduce PSP symptoms (Fischbach & Shah, 2006). Therefore, it is unclear how performance would change for PSP participants who were unselected to receive treatment. In other words, the behavioral addiction is still present among participants with PSP, but may manifest itself differently if wanting behavior change. Furthermore, Schuck and colleagues (2012) did not use the AAT as a cognitive intervention as in our study, but instead used it as an assessment at baseline among participants who were participating in another treatment outcome study. Most importantly, the above study was the first AAT study for PSP existing in the literature, so the direction of the AAT responses needs to be examined and replicated. Although this study's results from the AAT suggest a pattern of avoidance associated with PSP, we still hypothesize the opposite AAT tendency (i.e., pathological approach toward skin picking) in PSP based on the behavioral addiction account. Individuals with PSP are unlikely to be addicted to the visual

irregularity of the skin itself, but more so to the process and aftermath of picking (i.e., the feelings or gratification that accompany PSP behaviors). This internal focus of having to feel "just right", or reduce negative affect may contribute to the development of maladaptive, addictive picking behavior. Thus, it seems more reasonable for the AAT training to be geared toward increasing avoidance rather than approach in response to irregular skin pictures.

The Skin Picking Approach Avoidance Training (SP-AAT): A Pilot Investigation

The purpose of the SP-AAT was to cognitively redirect what one deems as desirable or aversive by modifying maladaptive action tendencies. Given our understanding of PSP as a behavioral addiction and the consequential gratification/relief that skin picking provides, we predicted that these individuals had an (pathological) approach tendency towards skin. Based on this conceptualization, the primary direction of the AAT promoted avoidance of skin materials. However, because of the lack of data on the effects of the Skin Picking-AAT (SP-AAT) on PSP action tendencies, we decided to include an additional training condition (geared toward approach) for exploratory purposes. Our study design consisted of three different training conditions: a) Approach Training (ApT; i.e., increasing approach tendencies toward irregular skin), b) Avoidance Training (AvT; i.e., increasing avoidance tendencies away from irregular skin), and c) Placebo Training (PT; i.e., equal training of approach and avoidance with irregular skin) for all PSP participants.

For this investigation, one important methodological consideration is what kind of skin materials should be used for the AAT assessment and training. Given the infancy of this line of investigation, there is a lack of empirical data to guide us in determining what kinds of skin stimuli are appropriate for the AAT investigation (e.g., pictures of healthy skin, irregular skin, or severely damaged skin due to PSP). We decided to use irregular skin as the primary stimulus in

our study for a few important reasons: 1) Schuck's study found that healthy skin and the control stimuli showed no difference in approach/avoidance behavior. This suggests that healthy skin is unlikely to be the central stimulus linked to the behavioral addiction of PSP. 2) Irregular skin is thought to provide a context where the urges for skin picking will be triggered and potentially make the behavioral addiction (i.e., approach tendencies) more pronounced and activated, thereby creating room for corrective training procedures (and also creating room for variation in AAT responses for the assessment purpose). 3) Damaged skin in itself is likely to cause avoidance due to its saliently aversive nature, thereby making it difficult to assess the more naturalistic action tendencies in response to the skin material. Therefore, we decided to use irregular skin as the target stimuli for this study. The proposed research functioned as a pilot study to guide the future directions of this line of investigation.

Aims and Hypotheses

The first aim of this study was to examine the underlying action tendencies associated with skin picking. Based on our conceptualization of PSP as a behavioral addiction, we hypothesized that those with PSP showed approach rather than avoidance tendencies to pictures of irregular skin. We further hypothesized that an approach tendency towards irregular skin would correlate with the current level of PSP symptoms as determined by skin picking measures (e.g., Skin Picking Scale-Revised).

Our second aim was to examine whether the AAT could modify action tendencies in PSP. Therefore, those in the AvT would decrease their approach tendencies to skin stimuli, while there would be no change in approach/avoidance for those in the PT. After training, those in the AvT would have a lower urge to pick, and those in the PT would have the same urges to pick as before on the BAT. Exploratory analyses involved the inclusion of ApT to determine its effects

on action tendencies. We hypothesized that those in ApT would increase approach tendencies to skin stimuli after training and report increased urges to pick on the BAT.

An exploratory aim was to determine the difference in symptoms at two-week follow up using the Skin Picking Scale-Revised (SPS-R). We hypothesized that those in the AvT would have lower PSP symptoms, those in the ApT would have higher PSP symptoms, and those in the PT would have no difference in PSP symptoms.

Method

Participants

Thirty-two individuals with PSP were recruited from the University of Wisconsin-Milwaukee (UWM) in exchange for compensation and/or course credit. **Inclusion criteria** were as follows: (1) moderate symptoms of skin picking (i.e. Skin Picking Severity Scale (SPS) score of ≥7 (Keuthen et al., 2001; Snorrason, Belleau, & Woods, 2012) (2) ages 18-60 (3) fluent English speakers. **Exclusion criteria** were as follows: (1) self-reported visual impairment that could not be adjusted and would prevent one from clearly recognizing words and pictures on a computer screen including color blindness, (2) positive diagnosis of bipolar disorder, psychotic disorder, current diagnosis of substance use disorder (moderate to severe), intellectual disability, or pervasive developmental disorder, and (3) non-English speakers. The mean age of participants was 22.44 years (SD=4.43) and participants were predominately female (87.8%). There were a variety of races reported: Asian (12.5%), Black/African American (6.25%) and White (68.75%). In terms of ethnicity, individuals from a Hispanic/Latino background represented 12.5% of our sample.

Recruitment

Participants were recruited through the UWM campus research portal, research flyers, newspaper outlets, and other related studies involving individuals with PSP. A variety of screening measures were conducted to make sure that participants were eligible for the study including (1) questionnaires to determine full eligibility before being invited to the main study and (2) a phone-screen to determine eligibility using PSP criteria on the OCRD module of the MINI 6.0. The opportunity to participate in the pre-screening procedures was announced to undergraduate classes by instructors and teaching assistants.

Measures

Skin picking severity scale (SPS-R). The SPS-R is an 8-item severity scale assessing impairment and symptom severity (Snorrason et al., 2012). Each item is rated on a 0 to 4 scale with a total score ranging from 0 to 32. The total of all the individual scores designates overall severity, and a sum higher than 7 represents severe or clinical skin pickers (Keuthen et al., 2001). The scale also has high internal, convergent/concurrent, and discriminant validity.

Milwaukee inventory of dimensions of adult skin picking (MIDAS). The MIDAS is a measure used to assess automatic and focused skin picking. There are 12 items, which are rated from a 1 (not true) to 5 (true), likert scale (Walther et al., 2009).

Mini international neuropsychiatric interview (MINI 6.0). The MINI is a brief diagnostic structured interview for the major Axis I psychiatric disorders. The administration can be completed in about 30 minutes (Sheehan et al., 2006). The purpose of this measure is to assess whether the individual meets any exclusion criteria (i.e., positive diagnosis of bipolar disorder, psychotic disorder, and current diagnosis of substance use disorder) of which they will not be able to participate.

Depression, anxiety and stress scale (DASS-21). The DASS-21 is a 21-item self-report instrument designed to measure the three related negative emotional states of depression, anxiety, and tension/stress (Lovibond & Lovibond, 1995).

Skin picking impact scale (SPIS). The SPIS is a 10 item self-report scale to assess psychological impact of SPD from the preceding week. Items are rated on a 6-point scale from 0 (none) to 5 (severe) (Keuthen et al., 2001).

Dermatological life quality index (DLQI). The DLQI is a 10-item questionnaire to measure how much skin problems have affected quality of life. Items are rated on a 4-point scale from 0 (not at all) to 3 (very much) (Finlay & Khan, 1994).

Procedure

After completing the pre-screening through the UWM campus research portal. Those who met criteria were either invited to the main study or discontinued. Once participants entered, they were assessed using the MINI 6.0, which took approximately 20 to 30 minutes. Those who did not meet criteria were also discontinued from the study. Eligible participants completed short questionnaires, as listed above, which took approximately 10-15 minutes. All of the pictures used in the computerized tasks were validated by graduate students who did not indicate a skin-picking problem. The graduate student ratings suggested that our pictures were acceptable to use for this task (Table 2). Next, all participants completed the follow steps (Figure 1):

Behavioral assessment task (BAT). All participants participated in a stress-challenge provocation task. Previous studies used the BAT for spider phobia or claustrophobia, which allowed for an adequate exposure under time constraints to address each of these fears (Powers, Smits, & Telch, 2004; Rinck et al., 2007). Likewise, for our BAT, participants were given 3 minutes to feel across their face, arms, legs, or other areas that did not feel "just right" using their

dominant hand. Without picking, they reported any flaws and urges to pick as they came across different area(s) of skin. The experimenter recorded any reported flaws, and measured urges on a scale of 0-100 where 0 indicated no urges to pick and 100 indicated a high urge to pick in that moment. This procedure was repeated for each area when the participant felt flaws or urges to pick. The task was completed twice, once before and after the AAT, to determine if there were any changes in urges to pick after training. The BAT took approximately 5 to 10 minutes.

Skin Picture Rating Task (SPR). The SPR task was created as an assessment tool to evaluate each participant's subjective view toward pictures of skin (pictures were different than those used in the assessment and training tasks). Participants were shown 7 pictures of irregular skin from various parts of the body (e.g., arm, fingers, legs, foot, etc.). Each photo had four questions rated on a sliding scale from 0 to 100 where 0 indicated "not severe" and 100 indicated "very severe". The questions were as follows: (1) How much does this picture look incomplete or not just right? (Incomplete) (2) How much does this picture bother or annoy you? (Bother/annoy) (3) How strong is your urge to make this picture "just right"? (Not just right experience (NJRE)) (4) How strong is your urge to pick your own skin after seeing this photo? (Urges). The task was completed before and after the AAT.

Eye tracking test. All participants completed a naturalistic picture-viewing task using an eye-tracking device (SMI RED250), presenting 10 slides. Each slide included 4 pictures in its four quadrants: (a) irregular skin, (b) healthy skin, (c) smooth wood, and (d) damaged wood. Participants were asked to view each slide for 15 seconds as if they were viewing a photo album without any constraints. From the task, the number of fixations (i.e., defined as the focused gaze within a 1 degree of visual angle for 100ms or longer), and their lengths were computed for each of the 4 areas of interest (AOIs). The results were comprised into the following eye-tracking

indices: total duration of fixation (TDF; amount of time at which the subject's eye enters the AOI until it leaves the AOI), fixation count (FC; the number of fixations for a given stimuli), and average fixation duration (AFD; the average duration of all fixations). This was administered before and after the AAT and took approximately 10 to 15 minutes. Based on eye-tracking data, we generated indices of gaze approach tendencies by comparing irregular skin to other stimuli; specifically wood and healthy skin. This was calculated in two ways: (1) we averaged the eye tracking indices for irregular skin and subtracted average wood (both smooth and damaged) from it (i.e., average wood – bad skin) (2) A more stringent gaze approach score included subtracting averaged healthy skin from averaged irregular skin (i.e., bad skin – good skin). Thus, the *Gaze Approach Index* was based on the "bad skin – good skin" score. Comparing the irregular and healthy skin stimuli are expected to provide the degree to which individuals are specifically approaching toward the irregular skin stimuli.

Simple Reaction Time (SRT) Task. The SRT is a measure of pure reaction time using a joystick. Participants pushed or pulled the joystick based on the stimulus presented on the screen. The purpose of this task was to evaluate whether visual-motor reaction speed was equivalent between groups. The task took approximately 5 minutes.

Approach avoidance assessment (AAA). Eligible participants completed the AAA before and after training to determine the participant's approach or avoidance to pictures of irregular skin. The assessment was the same for both the active and placebo groups. Participants looked at a computer screen and pushed or pulled a joystick at a 30-degree angle according to the format the pictures were assigned (i.e., landscape or portrait). The assessment task contained 96 trials: 4 pictures x 2 picture types (i.e., wood or irregular skin) x 2 formats (i.e., landscape or portrait) x 6 repetitions. The presentation of wood and irregular skin pictures was equal between

both formats so that no manipulation/training was done during this assessment period. The AAA-Behavioral Approach Index (overall RT) was calculated by subtracting the approach RT from the avoid RT (i.e., avoid RT – approach RT) for every participant. Therefore, positive scores would indicate a behavioral approach (i.e., faster RT to approach stimuli).

Training conditions. Participants were randomly assigned to the AvT (n=12), ApT (n=6), or PT (n=14) condition. The active trainings contained 384 trials: 8 pictures x 2 picture types (i.e., wood or irregular skin) x 2 border colors (i.e., green or red) x 12 repetitions. Individuals completed three sessions of the training condition they were randomly assigned to. These trainings are described below (Table 1).

Active avoidance training (AvT). Those in the AvT completed a training similar to the assessment task with the following changes: 1) participants pushed or pulled the joystick based on a rule assigned to the color of the border (i.e., blue or green) with each picture (i.e. irregular skin or wood). This change in format was meant to control for practice effects from the assessment task. 2) Pictures of irregular skin were always avoided (i.e. 100% avoidance), and pictures of wood were both approached and avoided (i.e. 50% approach and 50% avoidance). Thus, participants were trained to avoid skin. The wood as a control has no contingency; therefore, no training was necessary for this stimulus. Overall, we expected to see a decrease in behavioral approach to irregular skin stimuli.

Active approach training (ApT). Those in the ApT completed training similar to the AvT with the following exception: Pictures of irregular skin were always approached (i.e. 100% approach). Therefore, we expected to see an increase in behavioral approach to irregular skin stimuli.

Placebo training (PT). Those in the placebo training condition had a similar experience to those in the active trainings, except the rule for pushing or pulling irregular skin and wood stimuli was equally presented among the blue and green-bordered pictures (i.e. 50% approach and 50% avoidance of irregular skin stimuli and wood stimuli). We expected RT to remain unchanged for these participants.

Two-week follow-up. All participants were sent an email with a link to complete follow-up questionnaires (e.g., SPS-R, DASS-21, and SPIS), to determine any changes in PSP and other symptoms.

Data analytic plan

Hypothesis 1. Those with PSP would show approach rather than avoidance tendencies to pictures of irregular skin.

A paired sample t-test was conducted for the entire sample in our study to examine if mean differences in RT exist when approaching/avoiding pictures of irregular skin compared to pictures of wood. Specifically, we tested whether (a) Approach RT (for Skin) was shorter than Avoid RT (for Skin), which would indicate the overall behavioral approach in response to skin stimuli; and (b) Approach RT (for Skin) was shorter than Approach RT (for Wood), which would indicate the overall behavioral approach for skin as compared with the control stimulus.

Hypothesis 2. An approach tendency towards irregular skin would be correlated with the current level of PSP symptoms as determined by skin picking measures.

A Pearson product-moment *r* correlation was conducted for the entire study sample to assess the relationship between RT and PSP severity. Pearson *r* correlation is a bivariate measure of association (strength) of the relationship between two variables. Given that all variables were continuous (interval/ratio data) and the hypotheses sought to assess the

relationships, or how the distribution of the z scores varies, Pearson *r* correlation was the appropriate bivariate statistic. Cohen's standard will be used to interpret the magnitude of correlation coefficients, where 0.10 to 0.29 represents a weak association between the two variables, 0.30 to 0.49 represents a moderate association, and 0.50 or larger represents a strong association. Pearson's r correlation was also conducted to evaluate relationships among the BAT, cognitive tasks, self-report measures, and behavioral approach tasks including eye-tracking indices (i.e., TDF, FC, AFD) and gaze approach scores (i.e., bad skin-good skin; bad skin – wood), and SPR indices: (1) bother/annoy, (2) incomplete, (3) urges, and (4) NJRE.

Hypothesis 3. Those in the AvT would show decreased approach tendencies to skin stimuli, those in the ApT would show increased approach tendencies to skin stimuli, and those in the PT would show no change in approach or avoidance tendencies to skin stimuli.

A 3 (group) x 2 (time) mixed-factor repeated measures ANOVA was conducted. Initial values (i.e., when the first movement was made) and completed values (i.e. the length of time to finish the action) were averaged for all approach and avoidance trials per participant. For this manuscript, only completed RT values were reported; however, initial values were reported in Tables 7 and 8. We believe that completed RT provides an accurate depiction of the overall cognitive processes involved; therefore, completed RT was the primary index for this task across the different approach RT, avoid RT, and the behavioral approach index (i.e., overall RT). Normality was checked with skewness and kurtosis values, and sphericity was assessed through a Mauchly's Test of Sphericity.

Hypothesis 4. After training, those who completed the AvT would have a lower urge to pick, those in the ApT would have a higher urge to pick, and those in the PT would have no difference in urges to pick as determined by the BAT.

A 3 (group) x 2 (time) mixed-factor repeated-measures ANOVA was conducted to assess if mean differences in urges to pick exist at pre and post training. The continuous dependent variable of the analysis was urges to pick, measured 2 times. The Time X Group interaction effect was examined to test if there was a reduction in urges to pick across group. A repeated-measures ANOVA was also conducted for eye-tracking indices, the gaze approach index, and SPR, pre and post-training.

Exploratory hypothesis. At two-week follow-up, those in the AvT will have a decrease in PSP severity, those in the ApT will have an increase in severity, and those in the PT will have no difference in severity.

A 3 (group) x 2 (time) mixed-factor repeated measures ANOVA was conducted to assess if mean differences in PSP severity exist at pre-training and follow up.

Power analysis

Our power analysis was conducted using 3 x 2 repeated measures ANOVA with an alpha of .05, nonsphericity correction of 1, and correlation of 0.5. Based on this information, to conduct a standard power analyses to be used for multilevel models by multiplying the sample size by the design effect, the required sample size is 42 to achieve a large-sized effect with a power of 0.8 in detecting a large group by time interaction effect (f=.3). Currently, we have collected 32 participants, and are able to detect a medium-sized effect with a power of 0.5. Additionally, according to Leon and colleagues (2010), pilot studies are meant to focus on feasibility, and identify modifications before conducting a larger scale study.

Results

Demographic and Baseline Variables

Thirty-two participants were placed in either the AvT (n=12), ApT (n=6), or PT (n=14) groups. Table 3 shows demographic and clinical characteristics of our sample. There were no significant differences in terms of age, F (2,29) = .558, p=.58, or gender, X^2(2, N=32) = 2.58, p=.28 (Table 3). No between-group differences were observed on pre-training measures including the SPS-R, F (2,29) = .084, p=.920, MIDAS, F (2,29) = .218, p=.806, DASS-21, F (2,29) = .055, p=.947, SPIS, F (2,29) = .741, p=.481, or DLQI, F (2,29) = .778, p=464, BAT, F (2,29) = .776, p = .898. Additionally, no group differences were observed with the SRT (Figure 1; Table 3), BAT (Table 6), SPR (Table 7), AAT (Table 8 & 9), or eye tracking indices (Table 12 & 13) at pre-training.

Pre-training correlation analyses. A Pearson's correlation was used to evaluate the relationship between pre-training cognitive tasks, the BAT, and self-report measures (Table 10).

SPR Task Correlations. SPR Bother/Annoy was positively correlated with DASS-21 Total, r(32)=.350, p<.05. SPR Incomplete was positively correlated with MIDAS Total, r(32)=.390, p<.05. SPR Urges was positively correlated with SPS-R Total, r(32)=.483, p<.01, BAT, r(32)=.571, p<.01, DASS-21 Total, r(32)=.710, p<.01, and MIDAS Total, r(32)=.441, p<.05. Therefore, higher SPR scores were positively correlated with higher self-report skin picking severity and emotional symptoms, as well as urges to pick.

Eye-tracking Correlations. Based on the description used in the correlation matrix, "good skin" means healthy skin stimuli and "bad skin" means irregular skin stimuli. The TDF gaze approach index was significantly correlated with BAT, r(32)=.423, p<.05, SPR Urges, r(32)=.409, p<.05, and DASS-21 Total, r(32)=.417, p<.05. The FC gaze approach index was

significantly correlated with SPR Incomplete, $r(32)=.516$, $p<.01$, and SPR Urges, $r(32)=.426$, $p<.05$, and the AFD gaze approach index was significantly correlated with BAT, $r(32)=.450$, $p<.05$, SPR Urges, $r(32)=.416$, $p<.05$, and DASS-21 Total, $r(32)=.439$, $p<.05$. Overall, gaze approach to irregular skin significantly correlated with a greater urge to pick, SPR indices, and DASS-21 scores (Table 11).

Primary Aims

Action Tendencies and PSP Symptom Characteristics Before AAT

Behavior Addiction Hypothesis. The first aim of this study was to examine the underlying action tendencies on the AAA associated with skin picking. We hypothesized that those with PSP would show greater approach rather than avoidance tendencies to pictures of irregular skin. A paired sample t-test revealed a behavioral approach (i.e., greater approach tendencies on the AAA) to pictures of skin stimuli, $t(32) =-4.22$, $p<.01$.This same pattern was observed when comparing skin approach to wood approach, $t(32)=2.60$, $p=.014$. Participants did not show any differences in approach or avoidance to wood stimuli $t(32) =-1.71$, $p = .097$ (Figure 2; Table 5).

Relationship between Behavioral Approach and PSP Severity. We also hypothesized that a behavioral approach toward irregular skin would be correlated with current PSP symptoms as determined by the SPS-R. A Pearson's correlation showed a positive relationship between PSP symptoms and behavioral approach towards irregular skin, $r(32)=.579$, $p<.01$ (Table 10). In contrast, behavioral approach toward wood stimuli was not correlated with PSP symptoms $r(32)=.215$, $p>.05$.

Effects After AAT on Action Tendencies and Behavioral Outcomes

Changes in Action Tendencies. Our second aim was to examine whether the AAT could modify action tendencies in PSP. First, we hypothesized that after training, those in the AvT would show a decreased behavioral approach to skin stimuli, those in the ApT would show an increased behavioral approach to skin stimuli, and those in the PT would show no change. A 3 (condition) x 2 (time) repeated measures ANOVA was conducted to compare between group changes pre and post-training yielding a significant main effect of time for skin approach RT, F (1,28) = 31.40, p = .000, η_p^2 = .529, skin avoid RT, F (1,28) = 18.87, p = .000, η_p^2 = .403, wood approach RT, F (1,28) = 28.94, p = .000, η_p^2 = .508, and wood avoid RT, F (1,28) = 15.02, p = .001, η_p^2 = .349 (Table 8 and 9). In terms of training effectiveness, a significant group x time interaction was observed for skin stimuli, F (2,28) = 3.50, p = .044, η_p^2 = .200, but not wood stimuli, F (2,28) = 1.95, p = .161, η_p^2 = .122. The results suggest that after training individuals in the AvT and PT conditions showed a trend of decrease in their behavioral approach, while those in the ApT showed a trend of increase in their behavioral approach to skin stimuli. The AvT and PT groups both decreased their behavioral approach toward skin, but were not significantly different, $p > .05$ (Figure 3).

BAT. Second, we hypothesized that after training, those who completed the AvT would have a lower urge to pick, those in the ApT would have a higher urge to pick, and those in the PT would have no difference in urges to pick as determined by the BAT. A 3 x 2 repeated measures ANOVA revealed a significant time by group interaction after training, F (2,29) = 4.37, p = .022, η_p^2 = .231 (Table 5). Specifically, those in the ApT showed a trend of increase in urges to pick, and the AvT and PT participants showed a trend of decrease in urges to pick. Similar to the AAA

post-assessment, the AvT and PT groups were not significantly different after training on the BAT, p>.05 (Figure 4).

Eye-tracking and SPR. Eye-tracking results showed no significant differences away from irregular skin stimuli after training for TDF, FC or AFD (Table 12). Similarly, no differences were shown on SPR scores after training on any of the indices (i.e., Incomplete, Bother/Annoy, NJRE, Urges) (Table 6).

Two-Week Follow Up

Third, we hypothesized that at two-week follow up, those in the AvT would report decreased PSP severity, those in the ApT would report an increased PSP severity, and those in the PT would have no difference in skin-picking severity. No significant group x time interaction was observed on the self-report SPS-R measure, $F(2,28) = .609$, $p = .551$, $\eta_p^2 = 043$ (Figure 5).

Discussion

Within the OC-spectrum, PSP is considered a debilitating condition, which may lead to psychosocial impairment, lesions, scars, or infections. The disorder is considered a behavioral addiction because of the (1) urge, tension or anxiety before the behavior, (2) pleasurable sensation of picking, (3) gratification after the act, and (4) compulsion to repeat the behavior. As such, the purpose of this study was to evaluate whether a computerized training paradigm, the AAT, could be used to reduce dysfunctional approach action tendencies in individuals with PSP, and potentially reduce their skin picking symptoms.

Confirmation of the Behavioral Approach Hypothesis

First, we aimed to examine the underlying action tendencies associated with PSP. We found that individuals with PSP displayed a behavioral approach to pictures of irregular skin

exists, compared to a control stimulus (i.e., wood), which is consistent with our conceptualization of PSP as a behavioral addiction. Additionally, we found that a behavioral approach to irregular skin was correlated with greater symptom severity on the SPS-R. Neither a behavioral approach to wood stimuli, nor a correlation between wood and SPS-R were observed. The results suggest that an emotional salience to irregular skin stimuli exists in individuals with PSP. The results corroborated the need to implement avoidance training instead of approach training to reduce (pathological) approach tendencies to irregular skin stimuli for individuals with PSP.

Our findings on the behavioral approach tendency toward irregular skin were opposite of the baseline AAT results reported by Schuck and colleagues (2012). They found that a faster avoidance of irregular skin pictures (e.g., pimples, infections, and scabs) away from skin at baseline was significantly correlated with increased skin picking severity. Their results suggest that these individuals may have had an aversive response to pictures of skin as a result of their motivation for therapeutic change. Participants in their sample were only included if they reported motivation to undergo CBT treatment for their PSP, which may have led to stronger avoidance. This may have biased their participants to avoid skin materials during the AAT more readily at baseline. Further, participants were told to feel their skin once before the task, as well as between blocks to imagine what it was like to pick their skin while completing the task. This instruction may have distracted participants and potentially inhibited their true implicit response (e.g., approach) on the task. For our study, we did not feel the need to gauge motivation to change for two reasons. First, we aimed to understand implicit processes, so we did not want the participant to confound the meaning of approach or avoidance by allowing them to speculate about the desirable direction of action tendencies while participating in our study. For example,

participants might believe if they approach irregular skin then they condone their PSP behavior. This could have caused participants to bias their action tendencies in a way that was fitting to their desired motivation, instead of their actual implicit action tendencies (what we were targeting in this study). Second, a majority of our participants were moderate skin pickers who may not have considered their skin picking problematic or wanted change. Therefore, not asking about motivation to change may have controlled for this factor and provided a better accuracy in responses. Another consideration involves the averseness of pictures chosen for their study. Schuck and colleagues (2012), did not mention a systematic way of choosing skin pictures for their tasks. If the photos were gruesome, the natural response would be a faster avoidance tendency to remove the stimulus from the computer screen as quickly as possible. To address this in our study, we had doctoral students in clinical psychology, without reported skin picking problems, rate pictures to validate whether they were acceptable to use in our computerized tasks and questionnaires. All of the photos chosen met criteria and were generalized to a variety of body areas (Table 2). Therefore, we believe our photos adequately represented irregular skin stimuli.

Modification of Action Tendencies

Second, we aimed to examine whether the AAT could modify action tendencies in PSP. Our results revealed significant differences in approach and avoidance tendencies after training where the PT and AvT groups showed a trend of decrease in approach to irregular skin and the ApT group showed a trend of increase in approach from pre to post training, $p > .05$. No significant differences were found between the PT and AvT groups.

The results suggest that the PT (i.e., a blend of approach and avoidance training) provided comparable reduction of behavioral approach as the AvT. In contrast, solely

approaching pictures of skin did not help these individuals reduce their behavioral approach to irregular skin stimuli. The findings from the PT condition was unexpected, but suggests that the PT may be beneficial due to the existence of mixed motivations/action tendencies in PSP. It is quite common to observe ambivalent attitudes among individuals experiencing body-focused repetitive habit problems, including skin picking and hair pulling (Woods, et al. 2006; Diefenbach, Tolin, Hannan, Crocetto, &Worhunsky, 2005). It may be that the PT helped the individuals with PSP improve the ability to regulate the maladaptive fluctuation between approach and avoidance action tendencies in response to skin materials, while contributing to shifting the overall action tendency toward avoidance. Further research is needed to examine the mechanisms of change in the AvT and PT interventions.

Changes in Urges to Pick

The BAT revealed that those in the ApT had a higher urge to pick, while those in the PT and AvT had a lower urge to pick. Similar to the results above, no significant difference between the PT and AvT group were found, which suggests that both worked to reduce urges to pick at skin after training. The comparable findings between the AAA behavioral approach index and behavior suggest that a reduction in behavioral approach results in a reduction in urges to pick, while an increase in behavioral approach results in an increase in urges. Therefore, it was not surprising to see a decrease in urges in the AvT and PT group, and increase in urges in ApT because of their respective change in action tendencies to irregular skin after the AAT. The immediate effects of this training at a single time point of three sessions reveals the impact of this training on behavior, which is promising for future research.

Differences in Skin Picking Symptoms at Follow Up

We expected to see a difference in PSP symptoms at two-week follow up using the SPS-R; however, no differences were observed between groups in the two-week follow up. The results are contrasted with significant changes in urges were shown among the three groups. Several possible reasons may explain this. First, the lack of significant differences at two-week follow up may be due to the suboptimal potency of the single-session training (despite having three sessions combined), which did not demonstrate differences between the training groups. This single-session training was intended to determine the feasibility for future work. Future studies may consider increasing the number of training sessions, as well as spreading them out to genuinely train participants. This may be accomplished through bi-weekly training sessions for two to four weeks. Second, the time window between trainings at follow up may not have been enough to see self-reported changes in PSP symptoms. In other words, two weeks may not be enough to perceive and identify changes in symptom severity as a result of the training. Alternatively, it may be that symptom severity may change immediately after training. However, the limitations of the SPS-R symptom measure allowed for a check in symptoms only after two weeks. Thus, developing an outcome measure that can evaluate symptom change on a weekly or bi-weekly basis may be necessary. Third, it may also be that implicit changes in action tendencies and urges may be occurring, but not acknowledged by the participant. A potential solution may include awareness training (Azrin, & Nunn, 1973) a therapeutic technique which has the individual become more aware of their PSP urges/frequency, along with increased frequency of AAT, to help the individual acknowledge the change in urges so that they can report these differences on symptom measures. It would be interesting to evaluate BAT at follow-up to determine if changes occurred after two-weeks. If so, it may be that the BAT is a

better determining factor for improvement in PSP symptoms then self-report measures. This is because of the implicit nature of the AAT and the lack of awareness of the underlying processes occurring before and after training.

Eye tracking and Skin Picture Rating Task: Secondary Outcome Measures

The eye-tracking and SPR task were considered secondary outcome measures. Our findings showed that when individuals with PSP attend to irregular skin, they were more likely to experience worse emotional and skin picking symptoms, as well as urges to pick. Similar results were found with higher scores on the SPR. While changes in action tendencies and BAT scores were observed pre and post training, there were no significant differences in eye tracking or SPR indices. The results suggest that gaze approach tendencies may be a more entrenched process that is difficult to change with a single-session dose of training. Therefore, as suggested earlier, a greater number of training sessions that are spaced apart may allow for changes with eye-tracking indices. Nevertheless, the eye-tracking indices appear to be a promising measure to evaluate level of PSP severity before training occurs for a few reasons. First, gaze approach scores were positively correlated with a greater urge to pick and SPR indices. Thus, they seemed to be capable of indexing behavioral (i.e., eye gaze and overt attentional allocation) approach tendencies related to skin picking problems. Second, gaze approach scores from the eye-tracking were based on a very different paradigm compared to the AAA training program, and thus the association observed between gaze approach scores and other picking-related BAT and SPR indices were unlikely to be merely due to shared variance of assessment methodologies. Given that the AAA was very similar to the AAT program, and may be more vulnerable to the simple repetition/practice effects rather than reflecting an actual change in action tendencies, using a

proper secondary outcome measure such as gaze approach scores would be very important in this line of research.

The lack of changes in SPR suggests that the training may not have been potent enough. However, the SPR, as a self-report measure, was given to participants at post-training (i.e., not two weeks later), and differences were still not reported. Therefore, the findings lend support for the lack of acknowledgement in changes toward skin stimuli, which could be attenuated through awareness training or increased training sessions as mentioned above.

Limitations and Future Directions

This study is not without limitations. First, the training used pictures of irregular skin, but results may have varied if healthy skin or slightly more damaged skin were used. Irregular skin appeared to be the best option for this study so that pictures were not overly aversive for our moderate skin-picking sample. However, future research may consider using only healthy skin, slightly more aversive skin, or a mixture of both to determine what works best for training. Additionally, each individual that participated in our research study picked from different areas (e.g., arms, fingers, legs, and forehead). Focused training on these specific areas, which are more relevant to the individual may lead to better training response. We addressed this by generalizing the pictures used to a variety of body areas, but a more focused training may be necessary for the effects to be shown. A difficult, but potential useful solution may include showing the participant pictures of their own skin as compared to pictures of other's skin. Theoretically, the individual is addicted to picking his or her own skin. Thus, training the individual to avoid other people's skin may not have the same effect and thus not result in training differences.

Second, we chose individuals with moderate levels of skin picking. That is, self-report of 7 or higher on the SPS-R, and an informal diagnosis of skin picking disorder. Individuals in our

study also reported a habitual skin-picking problem that occurred more often than not. While a majority of individuals in our study reported that they disliked their skin picking habit, it was not required that these individuals report functional impairment or that their skin picking had negatively impacted their life. These factors may have influenced the results found. Future research should consider using a more severe clinical sample of those with PSP. These individuals may show greater, more significant, changes in action tendencies to irregular skin stimuli.

Third, the methodological conceptualization of the action of pushing or pulling (i.e. forward, backward, or side-to-side) is important to consider for this training task. Eder and Rothermund (2008) expanded upon this idea with their evaluative coding theory, which states that affective stimuli are dependent upon the evaluative meaning of the response labels. For example, perceptions of anger may intuitively be identified as avoidance, which could indicate withdrawal (or pulling response) from threat (Marsh, Ambday, & Kleck, 2005). Future research may consider individualizing the push/pull paradigm to the individual. For example, asking participants (before beginning the training) whether pushing means avoidance or approach to them, or whether it is more natural to push/pull in a forward or backward or side-to-side motion. Doing so may aid in achieving the intended result.

Fourth, participants completed this study in an laboratory setting where they would not normally pick. Research has shown that individuals with BFRBs are more likely to engage in the BFRB in private settings away from others (Teng, Woods, Twohig, & Marcks, 2002). While we attempted to provoke urges to pick through the BAT, our findings may not fully account for contextual differences where one typically acts on the behavior. Therefore, future research may examine whether conducting the training in a personally relevant contextual environment can

improve its potency. For example, having the participant complete the training at home when experiencing a mild to moderate level of urges for picking may improve training outcomes. This may also provide more long-lasting effects as the purpose of the training is to reduce PSP symptoms in environments that are more natural and salient to the individual.

Lastly, we had a small sample size with unequal groups. This pilot study was to determine the feasibility of the study. Additionally, we are still recruiting and plan to have a more even sample across groups. As the study continues, we expect to find new results, and confirm our findings thus far.

Significance and Innovation

While previous literature has supported the role of AAT among other areas of mental health (e.g. substance abuse, phobias, social anxiety) there is a paucity of research on the utility of this training for PSP. The proposed study was the first of its kind to introduce the SP-AAT as a computerized intervention to modify action tendencies, and reduce urges in individuals with PSP. Therefore, the preliminary effects of pictures containing skin irregularities on the action tendencies of PSP was carefully evaluated among all possible domains including approach and avoidance conditions, as well as, a placebo condition. After training, reduction in behavioral approach to irregular skin stimuli was observed in both the AvT and PT groups, and an increase in behavioral approach to skin stimuli was observed in the ApT group. Additionally, we found lower reported urges to pick in the AvT and PT groups, and higher urges in the ApT group. Not only has the study proven feasible, but the findings suggest that further study designed for developing the SP-AAT as a potential assessment and intervention is warranted. Future research should include a greater number of participants, a moderate to severe clinical PSP sample, and multiple training sessions. Successful implementation of this line of research can potentially lead

to as an additive treatment tool to behavior therapy and may be expanded to other impulse control disorders.

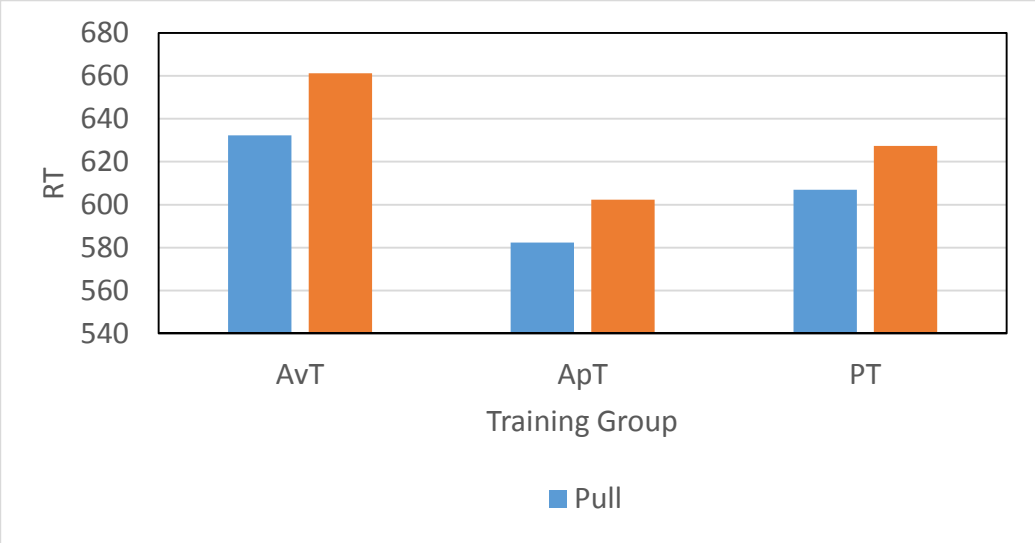

Figure 1. Pull and Push Speed on the Simple Reaction Time (SRT) Task

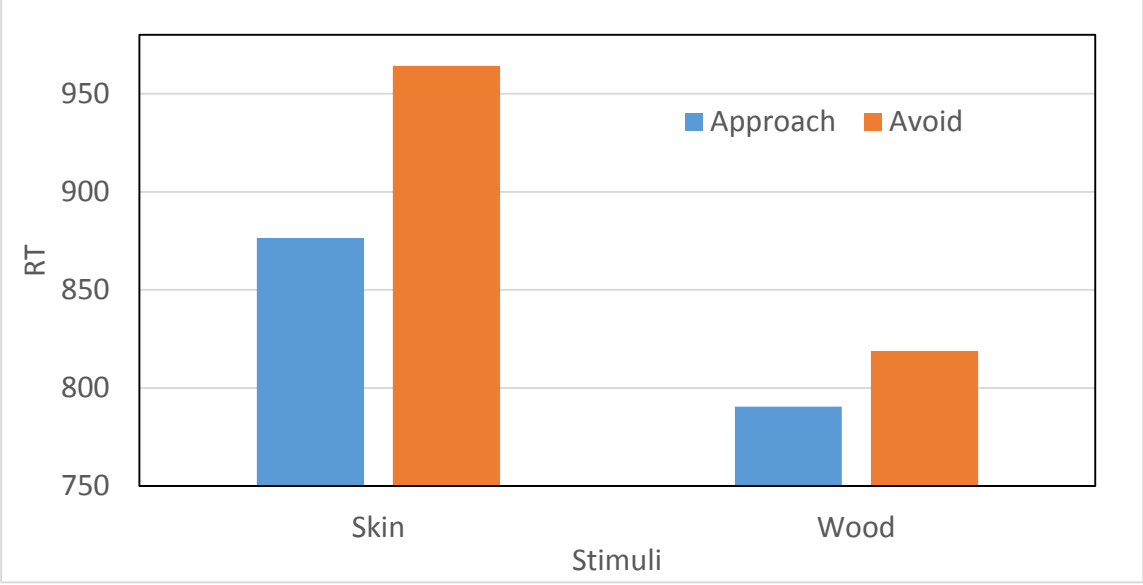

Figure 2. Behavioral Approach to Skin and Wood

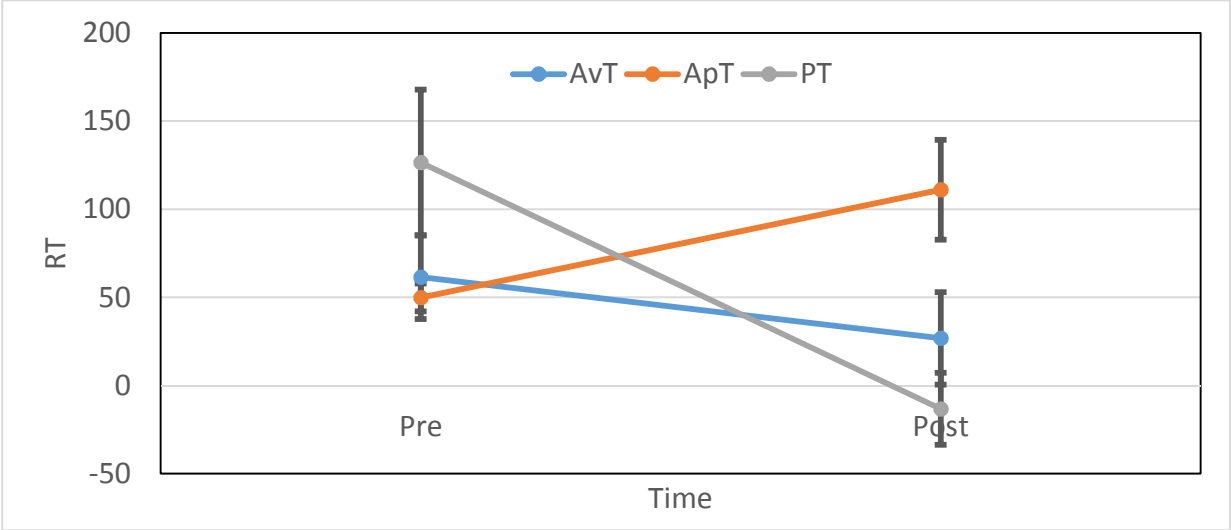

Figure 3. Changes in AAA Action Tendencies Pre- and Post-Training

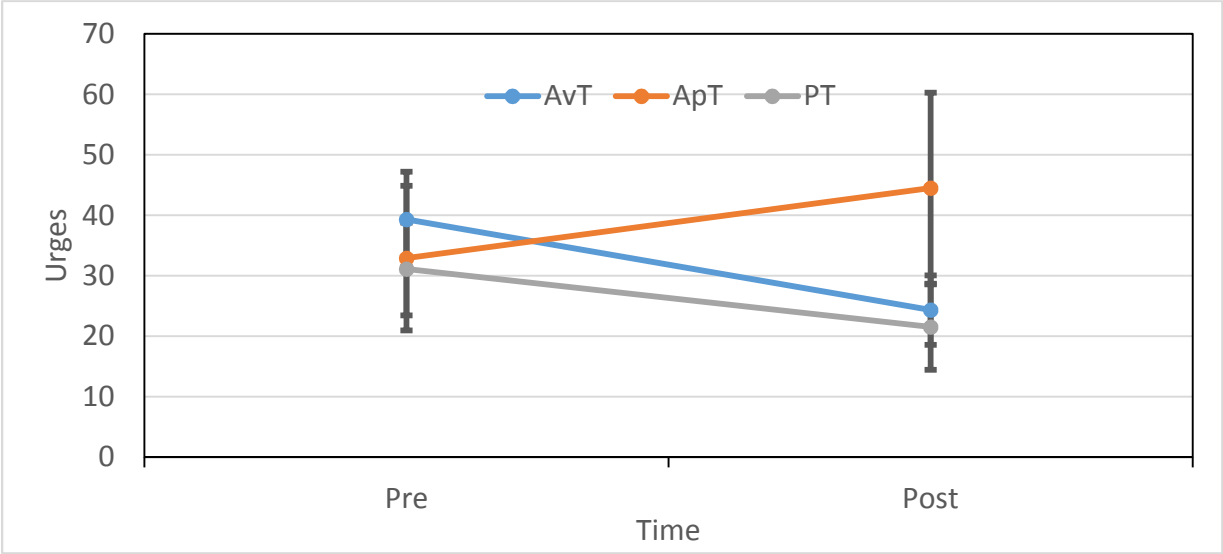

Figure 4. Changes in BAT Urges Pre- and Post-Training

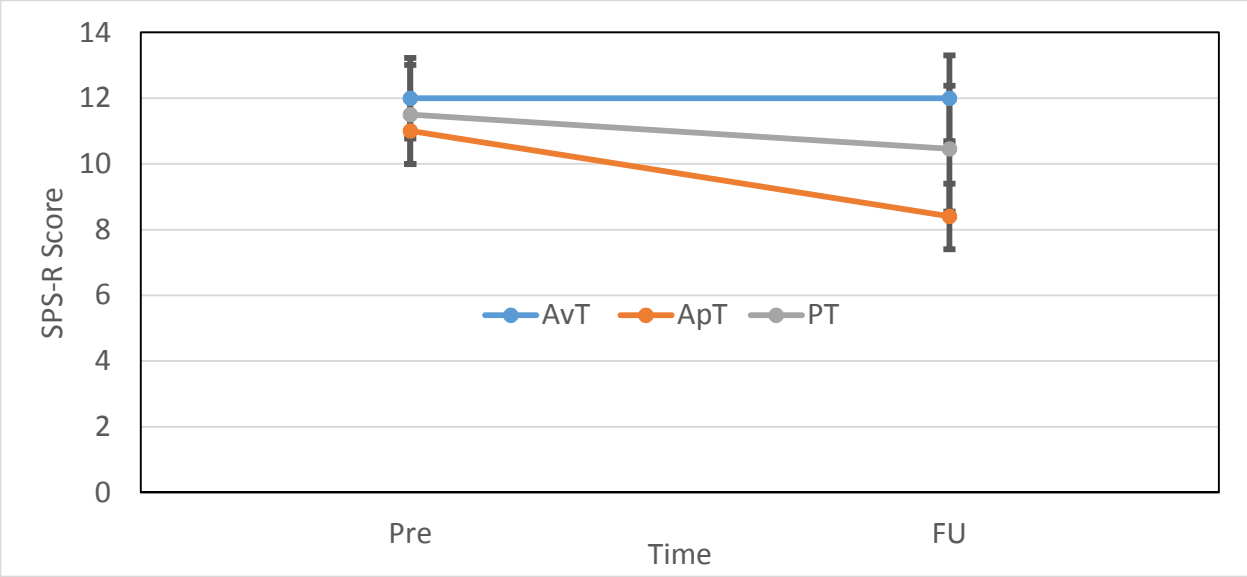

Figure 5. Changes in Skin Picking Symptoms Pre-Training and Two-Week Follow-Up

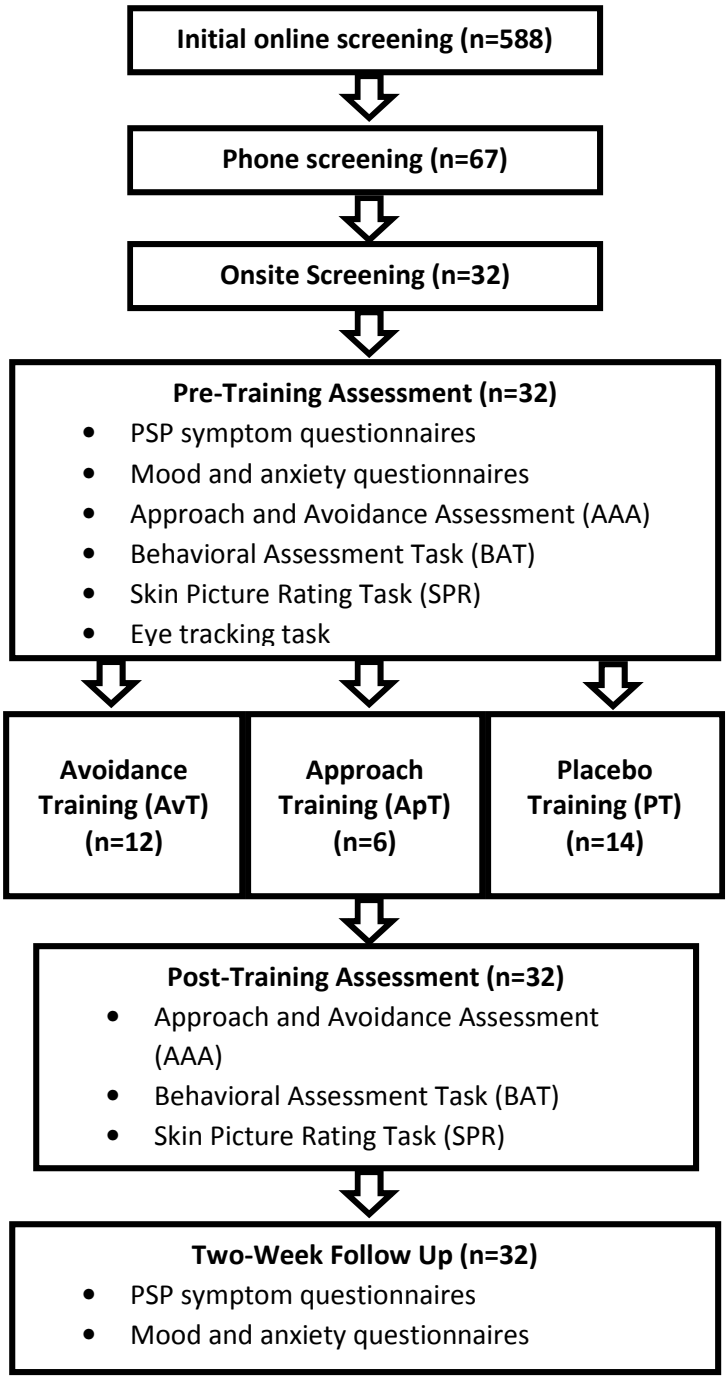

Figure 6. Complete Study Activities Flow Chart

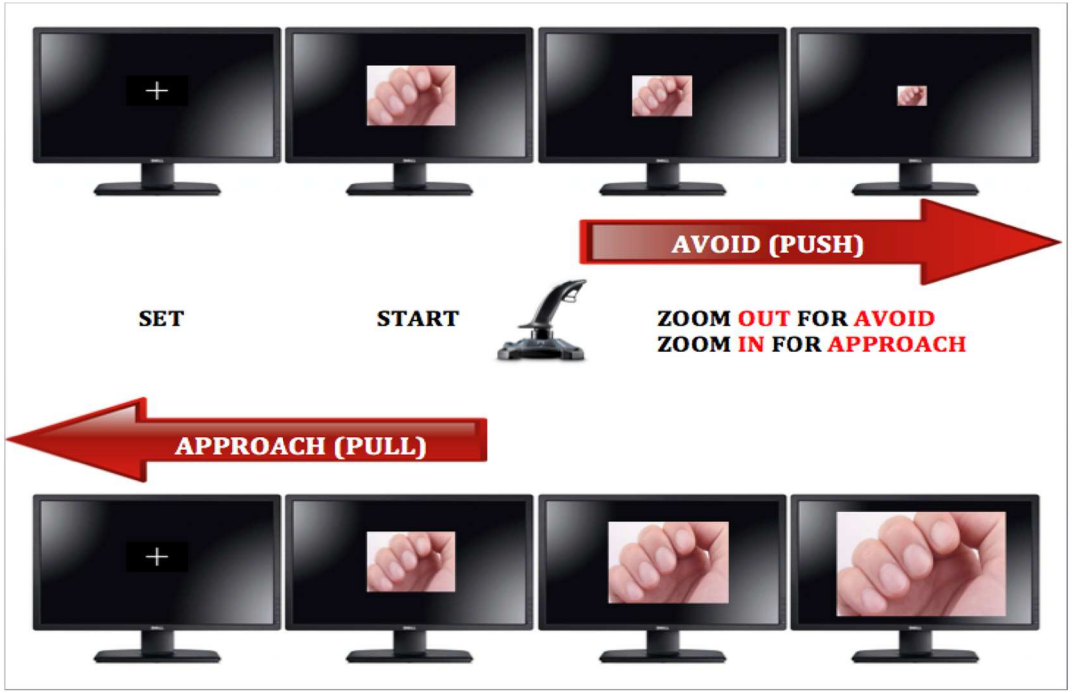

Figure 7. Illustration of the AAT. Pulling the joystick simulates an approach response with a zoom in effect, while pushing the joystick simulates an avoidance response and zoom out effect

Table 1.

Percentage of Time Stimuli are Approached and Avoided per Condition

Conditions	Approach Skin	Avoid Skin	Approach Wood	Avoid Wood
Approach	70%	0%	15%	15%
Avoidance	0%	70%	15%	15%
Placebo	35%	35%	15%	15%

Table 2.

Doctoral Level Graduate Student Ratings of Image. Pictures were rated along the following dimensions using a 0 - 100 sliding scale where 0 represented "healthy skin", 50 represented "irregular skin" (our target), and 100 represented "severely damaged skin". The following include the average, minimum, and maximum score across the photos. Photos that were rated near 50 were considered irregular skin.

	Mean	Minimum	Maximum
Skin Pictures	53.98	30.38	74.11

Table 3. Basic Demographic and Clinical Characteristics

	AvT (n=12)	ApT (n=6)	PT (n=14)	*F or* Chi Square Tests	*p*
	Mean (SD)	Mean (SD)	Mean (SD)		
Age	22.79 (7.44)	21.00 (2.90)	21.91 (4.57)	F (2,28) = .360	.701
Gender					
Male	20.0% (n=2),	16.7% (n=1)	0% (n=0)	X^2(2,32) = 2.58	.276
Female	80.0% (n=10)	83.3% (n=5)	100% (n=14)		
Race					
Asian	8.33% (n=1)	33.33% (n=2)	7.14% (n=1)		
Black or African Am.	0% (n=0)	16.67 (n=1)	7.14% (n=1)		
White	75.00% (n=9)	50.00% (n=3)	71.43% (n=10)		
Ethnicity					
Hispanic or Latino	16.67% (n=2)	0% (n=0)	14.29% (n=2)		
Not Hispanic or Latino	83.33% (n=10)	100% (n=6)	85.71% (n=12)		
Questionnaires					
SPS-R Total	12.00 (4.77)	11.00 (3.52)	11.5 (5.85)	F (2,29) = .084	.920
Frequency	7.75 (2.93)	7.17 (1.94)	7.07 (2.70)	F (2,29) = .224	.801
Impairment	4.25 (2.34)	3.83 (2.23)	4.43 (3.32)	F (2,29) = .094	.910
MIDAS Total	30.75 (7.29)	33.67 (12.58)	31.64 (8.43)	F (2,29) = .218	.806
Focused	15.00 (3.98)	16.83 (6.88)	15.92 (5.25)	F (2,29) = .268	.767
Automatic	18.75 (4.67)	16.83 (6.43)	19.86 (4.55)	F (2,29) = .783	.466
DASS-21 Total	39.67 (23.40)	44.33 (40.86)	42.71 (31.90)	F (2,29) = .055	.947
Depression	10.00 (8.22)	17.00 (14.79)	13.57 (13.43)	F (2,29) = .721	.495
Anxiety	13.00 (1.43)	10.67 (14.17)	14.14 (11.75)	F (2,29) = .174	.841
Stress	16.67 (6.17)	16.67 (15.47)	15.00 (10.86)	F (2,29) = .101	.905
SPIS	10.42 (10.82)	13.50 (7.37)	12.71 (14.10)	F (2,29) = .741	.481
DLQI	4.83 (3.10)	5.67 (5.65)	3.61 (4.09)	F (2,29) = .778	.464

Note. SPS-R = Skin Picking Scale – Revised; MIDAS = Milwaukee Inventory of Dimensions of Adult Skin Picking; DASS-21 = Depression, Anxiety, and Stress Scale; SPIS = Skin Picking Impact Scale; MINI 6.0. = Mini International Neuropsychiatric Interview; DLQI = Dermatological Life Quality Index; MDD = Major Depressive Disorder; OCD = Obsessive Compulsive Disorder; PTSD = Post-traumatic Stress Disorder; BDD = Body Dysmorphic Disorder; GAD = Generalized Anxiety Disorder

Table 4. Simple Reaction Time Between Groups

	AvT (n=12)	ApT (n=6)	PT (n=14)	[a]*F* Test
	Mean (SD)	Mean (SD)	Mean (SD)	*p*
SRT				
Pull				
Initial	504.62 (47.49)	470.69 (60.57)	485.58 (126.39)	F (2,29) = .293 p = .748 η_p^2 = .231
Complete	632.27 (57.12)	582.42 (85.72)	606.95 (145.48)	F (2,29) = .443 p = .646 η_p^2 = .030
Push				
Initial	516.97 (74.34)	480.09 (68.22)	483.60 (110.14)	F (2,29) = .536 p = .591 η_p^2 = .036
Complete	661.11 (88.35)	602.39 (95.91)	627.41 (134.62)	F (2,29) = .606 p = .552 η_p^2 = .040

Note: SRT=Simple Reaction Time; AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; Initial values (i.e., when the first movement was made) and complete values (i.e. the length of time to finish the action) were averaged for all approach and avoidance trials per participant.

Table 5. Differences in Approach and Avoidance Action Tendencies for Skin and Wood Stimuli

Stimuli	Mean (SD)	*t*-test, *p*
Skin		
Initial Values		
Approach	731.44 (224.21)	$t(32) = -4.03$,
Avoid	796.13 (291.24)	$p = .000$
Complete Values		
Approach	876.40 (262.74)	$t(32) = -4.22$,
Avoid	964.09 (351.40)	$p = .000$
Wood		
Initial Values		
Approach	656.11 (216.55)	$t(32) = -1.12$,
Avoid	672.12 (223.82)	$p = .270$
Complete Values		
Approach	790.50 (267.07)	$t(32) = -1.71$,
Avoid	818.94 (279.69)	$p = .097$
Skin and Wood		
Initial Values		
Skin Approach	731.44 (224.21)	t(32) =2.56
Wood Approach	656.11 (216.55)	p=.016
Completed Values		
Skin Approach	876.40 (262.74)	t(32) =2.60
Wood Approach	790.50 (267.07)	p=.014

Note: Initial values (i.e., when the first movement was made) and complete values (i.e. the length of time to finish the action) were averaged for all approach and avoidance trials per participant.

Table 6. Group Differences in BAT Outcomes at Pre and Post-training

	AvT (n=12)	ApT (n=6)	PT (n=14)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD	Mean (SD)	Mean (SD)				
BAT: Urge							
Pre	39.32 (31.40)	32.92 (28.85)	31.13 (28.69)	F (2,29) = .776, p = .898	F (2,29) = .476	F (1,29) = 1.577	F (2,29) = 4.37
Post	24.32 (21.56)	44.50 (33.79)	21.52 (26.37)	F (2,29) = 1.71, p = .198	p = .626, η_p^2 = .032	p = .219, η_p^2 = .052	p = .022, η_p^2 = .231

Note: BAT = Behavior Assessment Task; AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 7. Group Differences in SPR Task Outcomes at Pre and Post-training

	AvT (n=12)	ApT (n=6)	PT (n=14)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
SPR:							
Incomplete							
Pre	39.51 (24.89)	55.17 (19.80)	60.01 (25.02)	F (2,28) = 2.36, p = .113	F (2,28) = 2.39	F (1,28) = 8.272	F (2,28) = 1.53
Post	34.25 (23.64)	44.48 (30.05)	54.39 (26.92)	F (2,28) = 1.80, p = .184	p = .111, η_p^2 = .151	p = .008, η_p^2 = .235	p = .236, η_p^2 = .102
Bother/Annoy							
Pre	46.13 (26.56)	57.64 (19.21)	64.43 (26.45)	F (2,29) = 1.69, p = .202	F (2,27) = .996	F (1,27) = 3.87	F (2,27) = .257
Post	47.56 (20.59)	47.71 (28.26)	60.61 (22.20)	F (2,27) = 1.19, p = .317	p = .392, η_p^2 = .069	p = .059, η_p^2 = .125	p = .775, η_p^2 = .019
NJRE							
Pre	43.92 (34.50)	40.33 (21.85)	48.65 (27.30)	F (2,29) = ..175, p = .840	F (2,28) = .165	F (1,28) = 2.23	F (2,28) = .914
Post	42.23 (24.92)	40.29 (29.05)	41.63 (28.66)	F (2,28) = ..009, p = .991	p = .849, η_p^2 = .014	p = .149, η_p^2 = .085	p = .414, η_p^2 = .071
Urge to Pick							
Pre	42.76 (29.36)	30.55 (25.42)	33.71 (33.54)	F (2,28) = .418, p = .662	F (2,25) = .978	F (1,25) = 1.20	F (2,25) = .768
Post	37.21 (24.30)	19.50 (26.37)	31.45 (25.19)	F (2,25) = .936, p = .405	p = .390, η_p^2 = .073	p = .006, η_p^2 = .269	p = .475, η_p^2 = .058

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; SPR = Skin Picture Rating Task; NJRE = Not Just Right Experiences; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 8. Group Differences in AAA Task Outcomes at Pre and Post-training for Skin Pictures

	AvT (n=12)	ApT(n=6)	PT (n=14)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
Skin							
Approach RT							
Initial Values							
Pre	716.51 (177.30)	823.54 (226.09)	704.77 (262.15)	F (2,29) = .616, p = .547	F (2,28) = .222	F (1,28) = 32.79	F (2,28) = .3.96
Post	649.21 (120.61)	539.00 (70.47)	580.21 (183.92)	F (2,28) = 1.24, p = .304	p = .802, η_p^2 = .016	p = .000, η_p^2 = .220	p = .031, η_p^2 = .220
Complete Values							
Pre	855.31 (211.27)	984.78 (251.33)	848.02 (309.60)	F (2,29) = .615, p = .547	F (2,28) = .181	F (1,28) = 31.40	F (2,28) = 4.45
Post	798.06 (127.21)	688.38 (82.01)	740.44 (220.82)	F (2,28) = .835, p = .445	p = .835, η_p^2 = .013	p = .000, η_p^2 = .529	p = .026, η_p^2 = .229
Avoid RT							
Initial Values							
Pre	757.61 (222.79)	885.04 (256.89)	791.05 (360.34)	F (2,29) = .371, p = .693	F (2,28) = .171	F (1,28) = 23.26	F (2,28) = 1.22
Post	645.85 (148.53)	613.20 (37.65)	588.71 (149.67)	F (2,28) = .542, p = .587	p = .844, η_p^2 = .012	p = .000, η_p^2 = .454	p = .310, η_p^2 = .080
Complete Values							
Pre	916.73 (266.00)	1034.68 (246.26)	974.42 (454.72)	F (2,28) = .224, p = .800	F (2,28) = .163	F (1,28) = 18.87	F (2,28) = .837
Post	824.75 (159.62)	799.37 (94.92)	727.14 (180.48)	F (2,28) = 1.22, p = .312	p = .850, η_p^2 = .012	p = .000, η_p^2 = .403	p = .443, η_p^2 = .056
Overall							
Initial Values							
Pre	41.09 (81.83)	61.51 (51.61)	86.28 (109.43)	F (2,29) = .793, p = .462	F (2,28) = 1.97	F (1,28) = 2.05	F (2,28) = 1.23
Post	-3.37 (102.10)	74.20 (52.43)	8.50 (56.29)	F (2,28) = 2.22, p = .128	p = .158, η_p^2 = .124	p = .163, η_p^2 = .068	p = .308, η_p^2 = .081
Complete Value							
Pre	61.42 (82.58)	49.91 (26.10)	126.40 (154.77)	F (2,29) = 1.41, p = .261	F (2,28) = .572	F (1,28) = 1.64	F (2,28) = 3.50
Post	26.69 (117.68)	110.99 (38.13)	-13.30 (62.85)	F (2,28) = 4.61, p = .019	p = .571, η_p^2 = .039	p = .211, η_p^2 = .055	p = .044, η_p^2 = .200

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; RT=reaction time; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 9. Group Differences in AAA Task Outcomes at Pre and Post-treatment for Wood Pictures

	AvT (n=12)	ApT (n=6)	PT (n=14)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
Wood							
Approach RT							
Initial Values							
Pre	669.68 (136.87)	604.09 (326.20)	666.78 (231.32)	F (2,29) = .203, p = .818	F (2,28) = .871	F (1,28) = 29.05	F (2,28) = .1.08
Post	596.40 (100.20)	435.14 (216.76)	532.30 (118.55)	F (2,28) = 1.24, p = .304	p = .430, η_p^2 = .059	p = .000, η_p^2 = .509	p = .352, η_p^2 = .072
Complete Values							
Pre	797.71 (175.46)	749.40 (408.34)	801.94 (280.96)	F (2,29) = .083, p = .920	F (2,28) = .607	F (1,28) = 28.94	F (2,28) = 1.46
Post	752.48 (110.21)	572.14 (288.42)	679.32 (204.17)	F (2,28) = .835, p = .445	p = .552, η_p^2 = .042	p = .000, η_p^2 = .508	p = .250, η_p^2 = .094
Avoid RT							
Initial Values							
Pre	694.33 (121.45)	577.78 (290.84)	693.52 (263.42)	F (2,29) = .641, p = .534	F (2,28) = .774	F (1,28) = 21.38	F (2,28) = .499
Post	605.36 (109.22)	488.00 (242.74)	567.95 (142.58)	F (2,28) = 1.11 p = .345	p = .471, η_p^2 = .052	p = .000, η_p^2 = .433	p = .612, η_p^2 = .034
Complete Values							
Pre	842.72 (156.64)	696.63 (349.72)	850.98 (331.98)	F (2,29) = .695, p = .507	F (2,28) = 1.18	F (1,28) = 15.02	F (2,28) = .276
Post	788.37 (124.76)	602.17 (298.62)	732.15 (196.78)	F (2,28) = 1.71, p = .198	p = .324, η_p^2 = .077	p = .001, η_p^2 = .349	p = .761, η_p^2 = .019
Overall							
Initial Values							
Pre	24.65 (79.98)	-26.31 (111.42)	26.74 (65.52)	F (2,29) = 1.02, p = .373	F (2,28) = .499	F (1,28) = 4.25	F (2,28) = 2.60
Post	8.96 (76.30)	52.86 (46.67)	35.65 (41.81)	F (2,28) = 1.29, p = .292	p = .612, η_p^2 = .034	p = .049, η_p^2 = .132	p = .093, η_p^2 = .156
Complete Value							
Pre	45.01 (64.25)	-52.75 (138.14)	49.04 (80.99)	F (2,29) = 3.13, p = .060	F (2,28) = 2.07	F (1,28) = 2.25	F (2,28) = 1.95
Post	35.88 (78.00)	30.03 (77.86)	52.84 (49.19)	F (2,28) = .332, p = .720	p = .145, η_p^2 = .129	p = .145, η_p^2 = .074	p = .161, η_p^2 = .122

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; RT=reaction time; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 10. Group Differences in Outcome Measures at Pre-training and Follow-Up

	AvT (n=12)	ApT (n=5)	PT (n=14)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
SPS-R							
Total							
Pre	12.00 (4.77)	11.00 (3.52)	11.50 (5.65)	F (2,29) = .084, p = .920	F (2,28) = .402	F (1,28) = 1.99	F (2,28) = ..609
FU	12.00 (5.12)	8.40 (3.85)	10.46 (6.90)	F (2,28) = .697, p = .507	p = .673, η_p^2 = .029	p = .169, η_p^2 = .069	p = .551, η_p^2 = 043
Impairment							
Pre	4.25 (2.34)	3.83 (2.23)	4.43 (3.32)	F (2,29) = .094, p = .910	F (2,28) = .290	F (1,28) = .006	F (2,28) = .883
FU	4.83 (3.38)	3.40 (1.95)	3.92 (3.55)	F (2,28) = .417, p = .663	p = 750, η_p^2 = .021	p = .940, η_p^2 = .000	p = .425, η_p^2 = .061
Frequency							
Pre	7.75 (2.93)	7.17 (1.94)	7.07 (2.70)	F (2,29) = .224, p = .801	F (2,28) = .972	F (1,28) = 7.82	F (2,28) = 2.17
FU	7.17 (2.32)	4.17 (2.86)	6.54 (3.60)	F (2,28) = 2.03, p = .150	p = .391, η_p^2 = .065	p = .009, η_p^2 = .218	p = .133, η_p^2 = .134
DASS-21							
Total							
Pre	39.67 (23.40)	44.33 (40.86)	42.71 (31.90)	F (2,29) = .055, p = .947	F (2,27) = .321	F (1,27) = .037	F (2,27) = .809
FU	34.17 (19.72)	52.00 (45.50)	44.00 (34.47)	F (2,27) = .643, p = .533	p = .728, η_p^2 = .023	p = .850, η_p^2 = .001	p = .456, η_p^2 = .057
Depression							
Pre	10.00 (8.22)	17.00 (14.79)	13.57 (13.43)	F (2,29) = .721, p = .495	F (2,27) = .041	F (1,27) = .139	F (2,27) = 1.11
FU	7.67 (6.76)	19.20 (17.06)	13.54 (12.71)	F (2,27) = 1.93, p = .165	p = .960, η_p^2 = .003	p = .71, η_p^2 = .005	p = .344, η_p^2 = .076
Anxiety							
Pre	13.00 (11.43)	10.67 (14.18)	14.14 (11.75)	F (2,29) = .174, p = .841	F (2,27) = 2.07	F (1,27) = .030	F (2,27) = .671
FU	11.33 (9.08)	14.40 (15.58)	12.92 (11.45)	F (2,27) = ..143, p = .867	p = .145, η_p^2 = .129	p = .863, η_p^2 = .001	p = .520, η_p^2 = .047
Stress							
Pre	16.67 (6.17)	16.67 (15.47)	15.00 (10.86)	F (2,28) = .101, p = .905	F (2,27) = .150	F (1,27) = 2.07	F (2,27) = 2.07
FU	15.17 (8.02)	18.40 (15.32)	17.54 (12.06)	F (2,27) = .206, p = .815	p = .861, η_p^2 = .011	p = .145, η_p^2 = .129	p = .145, η_p^2 = .129
SPIS							
Pre	10.42 (10.82)	13.50 (7.37)	12.71 (14.10)	F (2,29) = .741, p = .481	F (2,27) = .404	F (1,27) = 1.10	F (2,27) = .740
FU	9.08 (7.72)	11.40 (5.81)	13.76 (13.03)	F (2,27) = .654, p = .528	p = .672, η_p^2 = .029	p = .303, η_p^2 = .039	p = .486, η_p^2 = .052

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; SPS-R = Skin Picking Scale – Revised; DASS-21 = Depression, Anxiety, and Stress Scale; SPIS = Skin Picking Impact Scale; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 11. Correlations among Self-Report Measures, BAT, Approach Avoidance Assessment, and Indices of the Skin Picture Rating Task at Baseline

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1.SPS-R Total	1																														
2.BAT	0.18	1																													
3.SPR Incomplete	-0.05	0.02	1																												
4.SPR Bother/Annoy	0.17	0.19	.54**	1																											
5.SPR NJRE	0.36	0.03	.68**	.65**	1																										
6.SPR Urges	.48**	.57**	0.24	0.27	.43*	1																									
7.DASS-21 Total	0.31	.45**	0.26	.35*	0.35	.71**	1																								
8.MIDAS Total	0.35	0.26	.39*	0.22	0.31	.44*	.66**	1																							
9.AAA Skin App.	.53**	0.07	0.15	0.19	0.26	0.17	0.28	0.33	1																						
10.AAA Skin Av.	.59**	0.11	0.10	0.23	0.32	0.20	0.28	0.28	.97**	1																					
11.AAA Overall Skin	.58**	0.19	-0.03	0.26	0.28	0.23	0.22	0.09	.66**	.83**	1																				
12.AAA Wood App.	.43*	0.21	0.24	0.32	.41*	0.31	0.33	0.31	.75**	.75**	.56**	1																			
13.AAA Wood Av.	.48**	0.29	0.13	0.26	.41*	.369*	0.30	0.27	.70**	.76**	.70**	.94**	1																		
14.AAA Wood Overall	0.21	0.25	-0.29	-0.14	-0.08	0.23	-0.02	-0.09	-0.05	0.13	.49**	-0.04	0.30	1																	
15.TDF Good Skin	0.04	-0.24	-0.42	0.04	-0.37	-0.23	-0.43	-0.28	-0.24	-0.24	-0.17	-0.30	-0.24	0.08	1																
16.TDF Bad Skin	-0.20	.43*	0.36	-0.01	0.14	.41*	0.25	0.17	-0.01	-0.02	-0.03	-0.04	-0.01	0.07	-0.27	1															
17.TDF Good Wood	0.04	-0.39	-0.28	-0.33	-0.31	-0.45	-0.24	-0.25	-0.02	0.03	0.12	0.03	0.02	-0.04	-0.36	-0.62	1														
18.TDF Bad Wood	0.18	-0.03	0.16	0.06	0.12	-0.02	0.14	0.22	0.34	0.28	0.07	.40*	0.28	-0.24	-0.46	-0.52	.43*	1													
19.FC Good Skin	0.01	-0.18	-0.26	-0.10	-0.25	-0.16	-0.50	-0.26	-0.35	-0.36	-0.30	-0.38	-0.31	0.11	.89**	-0.10	-0.38	-0.52	1												
20.FC Bad Skin	-0.07	0.31	.41*	-0.09	0.25	0.37	0.07	0.11	-0.01	-0.03	-0.07	-0.04	0.00	0.10	-0.20	.88**	-0.54	-0.49	0.12	1											
21.FC Good Wood	0.00	-0.22	-0.17	-0.43	-0.31	-0.38	-0.27	-0.20	-0.08	-0.05	0.01	0.00	0.02	0.05	-0.32	-0.57	.85**	.51**	-0.23	-0.43	1										
22.FC Bad Wood	0.09	0.07	0.12	-0.15	0.05	0.08	0.08	0.08	0.10	0.05	-0.07	0.17	0.14	-0.05	-0.43	-0.33	0.32	.86**	-0.35	-0.23	.546**	1									
23.AFD Good Skin	0.19	-0.27	-0.37	0.09	-0.14	-0.30	-0.32	-0.10	0.18	0.11	-0.05	0.07	-0.02	-0.25	.73**	-0.39	-0.19	-0.06	.45*	-0.43	-0.30	-0.31	1								
24.AFD Bad Skin	0.01	.39*	0.06	-0.16	-0.17	0.31	0.32	0.23	0.28	0.23	0.05	0.25	0.18	-0.13	-0.30	.57**	-0.34	0.02	-0.32	0.26	-0.30	0.05	-0.04	1							
25.AFD Good Wood	0.12	-0.40	-0.19	-0.25	-0.27	-0.38	-0.24	-0.08	0.14	0.13	0.09	0.13	0.05	-0.20	-0.38	-0.44	.80**	.50**	-0.43	-0.45	.533**	0.30	-0.01	-0.03	1						
26.AFD Bad Wood	0.15	-0.26	0.15	-0.06	0.02	-0.25	-0.09	0.26	.47*	0.34	-0.01	.41*	0.21	-0.46	-0.31	-0.37	0.38	.70**	-0.42	-0.38	0.28	0.35	0.32	0.18	.67**	1					
27.TDF Bad Skin-Wood	-0.19	0.39	0.27	0.04	0.13	0.38	0.19	0.12	-0.09	-0.08	-0.06	-0.14	-0.08	0.12	0.00	.96**	-0.74	-0.70	0.15	.85**	-.697**	-0.50	-0.22	.47*	-0.59	-0.51	1				
28.FC Bad Skin-Wood	-0.08	0.26	0.32	0.06	0.23	0.35	0.09	0.11	-0.02	-0.03	-0.04	-0.07	-0.04	0.08	0.02	.88**	-0.67	-0.70	0.23	.93**	-.680**	-0.55	-0.19	0.25	-0.54	-0.44	.93**	1			
29.AFD Bad Skin-Wood	-0.11	.55**	0.04	0.01	-0.03	.48*	0.36	0.06	-0.08	-0.06	0.01	-0.07	0.01	0.21	0.08	.74**	-0.72	-0.51	0.13	.53**	-.547**	-0.25	-0.18	.63**	-0.71	-0.61	.80**	.59**	1		
30.TDF Bad Skin-Good Skin	-0.16	.42*	.49*	-0.03	0.27	.41*	.42*	0.28	0.13	0.13	0.08	0.14	0.13	0.00	-0.76	.83**	-0.21	-0.09	-0.57	.71**	-0.20	0.03	-0.69	.56**	-0.08	-0.07	.65**	.58**	.46*	1	
31.FC Bad Skin-Good Skin	-0.07	0.38	.52**	-0.03	0.40	.43*	0.34	0.24	0.18	0.17	0.09	0.17	0.17	0.03	-0.66	.84**	-0.29	-0.16	-0.43	.85**	-0.27	-0.02	-0.63	.41*	-0.18	-0.12	.69**	.72**	.41*	.95**	1
32.AFD Bad Skin-Good Skin	-0.14	.45*	0.32	-0.16	-0.04	.41*	.44*	0.21	0.04	0.05	0.07	0.10	0.13	0.11	-0.74	.65**	-0.06	0.06	-0.54	.48*	0.04	0.26	-0.79	.65**	-0.01	-0.13	.46*	0.30	.53**	.87**	.73**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Note. SPS-R = Skin Picking Scale-Revised; BAT = Behavioral Assessment Task; SPR = Skin Picture Rating task; DASS-21 = Depression, Anxiety, and Stress Scale; MIDAS = Milwaukee Inventory of Dimensions of Adult Skin Picking; AAA = Approach-Avoidance Assessment; App. = Approach; Av. = Avoid; TDF = Total Duration of Fixation; FC = Fixation Count; AFD = Average Fixation Duration

Table 12. Group Differences in Eye-Tracking Indices with Skin Pictures at Pre and Follow-Up Treatment

	AvT (n=9)	ApT (n=5)	PT (n=12)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
Total Duration Fixation							
Good Skin							
Pre	3984.92 (3620.90)	2744.75 (1206.12)	2884.74 (1059.29)	F (2,23) = .723, p = .496	F (2,23) = 1.19	F (1,23) = 0.31	F (2,23) = 2.27
Post	4425.82 (3641.34)	2414.84 (1447.64)	2684.94 (1377.59)	F (2,23) = 1.54, p = .236	p = .321, η_p^2 = .094	p = .862, η_p^2 = .001	p = .126, η_p^2 = .165
Bad Skin							
Pre	4599.13 (2793.26)	4541.46 (3451.31)	4504.11 (2495.35)	F (2,23) = .003, p = .997	F (2,23) = .196	F (1,23) = .029	F (2,23) = 1.02
Post	4580.35 (2406.76)	5451.09 (3545.09)	3836.53 (2690.90)	F (2,23) = .651, p = .530	p = 823, η_p^2 = .017	p = .867, η_p^2 = .001	p = .377, η_p^2 = .081
Fixation Count							
Good Skin							
Pre	9.04 (4.51)	6.44 (2.86)	7.18 (3.24)	F (2,23) = 1.01, p = .378	F (2,23) = .760	F (1,23) = 3.45	F (2,23) = .123
Post	10.86 (4.49)	10.07 (4.50)	9.45 (6.31)	F (2,23) = 1.64, p = .215	p = .479, η_p^2 = .062	p = .076, η_p^2 = .130	p = .885, η_p^2 = .011
Bad Skin							
Pre	12.11 (7.32)	8.80 (4.21)	9.45 (6.31)	F (2,23) = .440, p = .649	F (2,23) = .283	F (1,23) = .162	F (2,23) = .563
Post	10.86 (4.49)	10.07 (4.50)	9.45 (6.31)	F (2,23) = .160, p = .853	p = .756, η_p^2 = .024	p = .691, η_p^2 = .007	p = .577, η_p^2 = .047
Average Fix. Duration							
Good Skin							
Pre	356.97 (200.78)	416.39 (186.74)	308.53 (52.86)	F (2,23) = .997, p = .384	F (2,23) = 1.14	F (1,23) = .027	F (2,23) = 2.72
Post	464.33 (393.69)	357.06 (250.09)	276.60 (86.87)	F (2,23) = 1.45, p = .255	p = .337, η_p^2 = .090	p = .870, η_p^2 = .001	p = .087, η_p^2 = .191
Bad Skin							
Pre	316.96 (99.19)	440.78 (174.06)	296.33 (80.73)	F (2,23) = 3.24, p = .058	F (2,23) = 3.63	F (1,23) = .067	F (2,23) = .394
Post	350.63 (163.12)	454.55 (224.72)	272.96 (121.27)	F (2,23) = 2.49, p = .104	p = .043, η_p^2 = .240	p = .799, η_p^2 = .003	p = .679, η_p^2 = .033

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; ME Group = Main Effects of Group; ME Time = Main Effects of Time

Table 13. Group Differences in Eye-Tracking Indices with Wood Pictures at Pre and Follow-Up Treatment

	AvT (n=9)	ApT (n=5)	PT (n=12)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
Net Dwell Time							
Good Wood							
Pre	2201.62 (1377.95)	2591.74 (1220.91)	2993.60 (1717.73)	F (2,23) = .695, p = .509	F (2,23) = 1.44	F (1,23) = .221	F (2,23) = .829
Post	1595.18 (857.07)	2415.61 (1308.71)	3299.95 (2905.23)	F (2,23) = 1.58, p = .226	p = .259, η_p^2 = .111	p = .643, η_p^2 = .010	p = .449, η_p^2 = .067
Bad Wood							
Pre	3306.05 (2130.02)	4285.91 (1742.55)	2882.45 (1647.98)	F (2,23) = 1.02, p = .376	F (2,23) = 1.19	F (1,23) = 2.26	F (2,23) = .054
Post	2943.93 (1517.74)	3799.64 (1189.12)	2602.56 (1634.56)	F (2,23) = 1.13, p = .338	p = 323, η_p^2 = .094	p = .146, η_p^2 = .090	p = .948, η_p^2 = .005
Fixation Count							
Good Wood							
Pre	5.78 (3.74)	6.20 (3.39)	6.13 (3.02)	F (2,23) = .038, p = .963	F (2,23) = .409	F (1,23) = .726	F (2,23) = .615
Post	4.23 (2.26)	5.80 (3.45)	6.25 (4.45)	F (2,23) = .888, p = .425	p = .669, η_p^2 = .034	p = .403, η_p^2 = .031	p = .549, η_p^2 = .051
Bad Wood							
Pre	9.02 (5.24)	8.60 (2.86)	6.38 (3.49)	F (2,23) = 1.22, p = .315	F (2,23) = .678	F (1,23) = 2.99	F (2,23) = 1.87
Post	10.86 (4.49)	10.07 (4.50)	9.45 (6.31)	F (2,23) = .291, p = .750	p = .518, η_p^2 = .056	p = .097, η_p^2 = .115	p = .176, η_p^2 = .140
Average Fix. Duration							
Good Wood							
Pre	298.63 (94.26)	355.29 (128.50)	345.73 (141.28)	F (2,23) = .483, p = .623	F (2,23) = .858	F (1,23) = 1.65	F (2,23) = .205
Post	257.94 (106.20)	345.06 (107.06)	323.61 (138.25)	F (2,23) = .290, p = .751	p = .437, η_p^2 = .069	p = .212, η_p^2 = .067	p = .816, η_p^2 = .018
Bad Wood							
Pre	278.46 (92.78)	456.06 (293.51)	286.86 (108.77)	F (2,23) = 2.56, p = .099	F (2,23) = 2.38	F (1,23) = .039	F (2,23) = 2.40
Post	354.91 (187.53)	400.93 (209.71)	249.19 (85.84)	F (2,23) = 2.43, p = .109	p = .115, η_p^2 = .171	p = .845, η_p^2 = .002	p = .113, η_p^2 = .173

Note: AvT = Avoidance Training; ApT = Approach Training; PT = Placebo Training; ME Group = Main Effects of Group; ME Time = Main Effects of Time

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APPENDIX: Behavior Assessment Task Rating Sheet

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0 25 50 75 100

1. Are you feeling any urges to pick? **Where?**

    1. _____
    2. _____
    3. _____
    4. _____
    5. _____

2. On a scale of 0 to 100, where 0 indicates no urge to pick and 100 indicates a severe urge to pick, what is your urge to pick on this scale?

    1. _____
    2. _____
    3. _____
    4. _____
    5. _____

Please include notes if applicable.