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# Visual Attention Patterns of Socially Anxious Individuals When Using Facebook: An Eye Tracking Study

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**Social networking sites (SNSs) are an increasingly used medium for social interactions. For socially anxious individuals, SNS-based communication is often preferred over traditional face-to-face socializing. Yet, research on SNSs usage and social anxiety is still less common, with extant studies being mostly correlational among healthy nonanxious participants. Conversely, here, we examined differences in actual gaze patterns to social and nonsocial stimuli between socially anxious and nonanxious individuals while using Facebook. Socially anxious and nonanxious student participants freely viewed a genuine Facebook profile page designed for the present study, for 3.5 minutes, containing 12 social and 12 nonsocial picture stimuli. Gaze patterns on social and nonsocial areas of interest (AOIs) were explored. Subjective uneasiness experienced when viewing the social pictures and state anxiety were also assessed. Finally, 2 weeks following the task, we evaluated participants' willingness to participate in a follow-up (fictitious) study that required them to passively view their own Facebook profile, and then to actively use it. Results showed that compared with nonanxious participants, socially anxious participants demonstrated a viewing pattern less favoring social pictures, reflecting an attentional avoidance tendency. A significant inverse correlation between subjective uneasiness and percent of dwell time spent on the social AOI emerged. Socially anxious participants also reported higher levels of state anxiety, which was significantly positively correlated with uneasiness scores. Finally, socially anxious participants were also less willing to actively use their Facebook profile page. This study suggests that social anxious individuals are characterized by attentional and behavioral avoidance tendencies when using Facebook.**

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SOCIAL ANXIETY DISORDER (SAD) is described as intensive fear reactions triggered by a wide variety of social situations (American Psychiatric Association, 2013). It is highly prevalent, causing significant anxiety and personal distress, as well as posing a huge economic burden on society (Stein & Stein, 2008). Examples of social situations include, among others, social interactions (e.g., having a conversation, meeting unfamiliar people), being observed while engaging in different daily activities (e.g., eating or drinking), and performing in front of others (e.g., giving a speech). The experienced subjective distress and anxiety associated with social encounters are usually followed by persistent behavioral avoidance of anxiety-provoking situations, limiting the individual's social life and impeding his/her achievements in both education and work settings (Stein & Stein, 2008). Interestingly, most commonly used examples and definitions of social anxiety relate primarily to fear reactions occurring while in actual (or imagined) interpersonal encounters taking place in the "real" social world (Yen et al., 2012).

Concurrent with the development of a technological world, an actual physical encounter is no longer needed or necessary for social interactions and/or communication to occur, as alternative, technology-based social infrastructures have emerged. Indeed, internet-based interpersonal and group interactions are a significant part of

human daily social life (Perrin, 2015), becoming even more common in the era of the Coronavirus pandemic (COVID-19; Depoux et al., 2020), which forced many to resort to these platforms to avoid physical face-to-face encounters. While some virtual online interactions belong to the "-Web and Video Conferencing" category (i.e., Zoom), the major platform for socially connecting to others is still social networking sites (SNSs), such as Facebook, which offer a unique blend of interpersonal and mass communication. As of March 2020, there are approximately 2.5 billion monthly active Facebook users, making it the largest and most popular social media network in the world (DremGrow, 2020). In Facebook, users create personal electronic profiles, provide general and private details about their lives and experiences, post pictures, maintain relationships, plan social events, and meet new people. In addition, users can observe, comment and give feedback on others' profile pages (Nadkarni & Hofmann, 2012). Thus, with the rise of SNS infrastructures as a major medium for social communication and interaction, it seems highly important to examine the implications of social anxiety also in this novel and increasingly used social environment.

Research on SNS usage and social anxiety is still less common compared with research on the effects of social anxiety in "real-world" social environments (Prizant-Passal et al., 2016). Extant research has been mainly correlative, exploring potential associations between social anxiety symptoms and different aspects of SNSs (primarily Facebook) among healthy nonanxious participants. These include, among others, preference for SNS usage (e.g., Erwin et al., 2004; Shaw et al., 2015), SNS profiles specifications (e.g., Fernandez et al., 2012), SNS addiction (e.g., Weinstein et al., 2015), and problematic SNS usage (e.g., Lee & Stapinski, 2012). While considerably advancing our knowledge in the field, research on the ways in which socially anxious, compared with nonanxious individuals, actually perceive and process social and nonsocial information while using SNSs has been relatively scarce. Recently, a study using eye tracking, a methodology widely used to characterize attentional aspects of SNS usage in healthy individuals (e.g., Vraga et al., 2016), has explored the relationship between gaze-related data during Facebook usage and mental well-being (Hussain et al., 2019). Specifically, participants' gaze was recorded while on Facebook, with fixations coded as either directed to *social* or to *update* areas of the Facebook interface, and then correlated with self-reported anxiety and depression. However, no significant correlates with anxiety scores emerged. Importantly, as in most previous research on SNS usage and social anxiety, this study was also correlative, using a sample of healthy participants with low baseline rates of anxiety and depression (Hussain et al., 2019). Hence, we are not aware of any study to date that used eye-tracking methodology to compare actual gaze patterns of socially anxious and nonanxious individuals to different socially and nonsocially-relevant stimuli appearing on an SNS such as Facebook.

Some preliminary predications concerning the above-stated research query might be inferred from more traditional research examining the assertions of cognitive models of SAD, which consistently implicate information processing biases, including biased attention, in the development and maintenance of the disorder (Clark & Wells, 1995; Rapee & Heimberg, 1997). Using different eye-tracking-based tasks and paradigms, research usually compares the attention allocation patterns of socially and nonsocially anxious participants while viewing different emotional stimuli presented concurrently (usually socially relevant vs neutral stimuli) thereby "competing" over one's attention. All eye-data facets (e.g., saccades, fixations) are recorded and then used to characterize participants' attentional patterns and describe group differences in gaze-related behavior reflecting different attentional processes and biases (Lazarov et al., 2019). Free-viewing, one of the most widely used tasks in visual attention research, during which participants freely view arrays of stimuli without any specific requirements or demands, can help illustrate this process. Examining the location and the latency of initial fixations occurring immediately after stimulus onset, namely, first fixations, can be used to index *biased threat detection/vigilance*. A greater proportion of first fixations on threat compared with neutral stimuli, or shorter latencies to first fixate on threat compared with neutral stimuli, are considered evidence of facilitated threat detection (Armstrong & Olatunji, 2012). Accumulating the durations (i.e., total dwell time) of all fixations made during stimulus presentation per specific stimuli type can be used to reflect ongoing attention allocation. Increased attention allocation to threat over neutral stimuli can be used to reflect *sustained attention* on threat (Lazarov et al., 2016), with the opposite pattern indicating *attentional threat avoidance* (Chen et al., 2012).

Extant research has shown social anxiety to be associated with attentional biases in several aspects or components of the attentional process (for a general review see Armstrong & Olatunji,

2012; for a more specific review in SAD see Chen & Clarke, 2017). Specifically, some have found evidence for threat-related vigilance, finding socially anxious participants to direct their gaze more often or more quickly to emotional over neutral faces (e.g., Garner et al., 2006). Some have found evidence for sustained attention on threat, reporting increase total dwell time on threat-related vs. neutral stimuli (e.g., Lazarov et al., 2016), while others found the opposite pattern, interpreted as reflecting attentional threat avoidance (e.g., Chen et al., 2012; Chen et al., 2015; Rubin et al., 2020; Singh et al., 2015).

Trying to explain this mixed finding in SAD, some have suggested that social anxiety may be related to different combinations of the above-described attentional components as these are not necessarily mutually exclusive, and might simply operate at different stages of information processing (Lazarov et al., 2019). Indeed, a review of gaze-based assessment of visual attention in socially anxiety concluded that social anxiety may be related to a mixture of both vigilance and avoidant (Chen & Clarke, 2017). A second possibility is that the varied findings in the field might be related to the different methods and tools employed across studies, as well as to the ecological validity of the tasks used to assess attention allocation patterns (Chen & Clarke, 2017). For example, stimuli array size varies significantly across studies, ranging from 2 (e.g., Garner et al., 2006) to 16 (e.g., Lazarov et al., 2016) stimuli presented at once. Studies also widely vary on task demands while eye-date is being recorded, with some using more traditional reaction-time-based tasks such as the dot-probe (e.g., Schofield et al., 2012) or visual search (e.g., Wermes et al., 2018), some using free-viewing paradigms (e.g., Buckner et al., 2010), and others assessing eye data while participants are engaged in a stress-inducing task such as public speaking (e.g., Chen et al., 2015; Lin et al., 2016; Rubin et al., 2020). The importance of the generalizability and ecological validity of tasks used to assess attentional patterns was further emphasized by Richards et al. (2014), who recommended using visual displays better resembling real-world settings to better elucidate the involved attentional processes. Social media seems like one such setting worth exploring, as it is on the rise world-wide and across generations, while also being less limited by traditional standard laboratory settings.

Here, using eye-tracking methodology, we monitored gaze patterns of socially anxious and nonanxious participants while viewing a genuine Facebook profile page, specifically designed for the present study. The Facebook profile page contained 12 social-relevant pictures, based on items taken from the Liebowitz Social Anxiety Scale questionnaire (Liebowitz, 1987; see Measures below), and 12 nonsocial pictures, presented sequentially as is customary on Facebook. We measured total dwell time spent on each of these two types of stimuli. Based on the above-described eye-tracking research in social anxiety (Chen & Clarke, 2017), we predicted that the two groups would show different patterns of attention allocation while viewing the Facebook profile page, with socially anxious participants showing more avoidant tendencies. Because social anxiety generally refers to feelings of *uneasiness* in social situations (e.g., Myllyneva et al., 2015), with developmental models considering uneasiness to figure prominently in the etiology and maintenance of social anxiety disorder (Kagan, 2014), we also assessed the subjective levels of uneasiness participants experienced while viewing the social-relevant pictures embedded within the Facebook page. Finally, as social anxiety and depression tend to co-occur (e.g., de Jong et al., 2012), with previous findings showing depressed individuals to differ from control participants on attention allocation to different-valenced stimuli (for a review see Suslow et al., 2020), we also measured participants' depression levels.

While the above-described eye-tracking task was designed to assess actual gaze patterns when using Facebook, obtained results cannot attest to the a-priori willingness of participants, or lack of, to behaviorally engage and use Facebook. As willingness to participate in the present study was high (all participants who were invited to participate in the present study, with no exceptions, agreed to participate), we aimed at examining participants' behavioral tendencies when needing to use their own Facebook profile page. Thus, we also evaluated the (same) participants' willingness to take part in a similar two-part follow-up study that required them first to *passively* view their own Facebook profile page, rather than *another's,* as was done in the eye tracking task, and then to *actively* share personal information online (i.e., moving from a *passive* to an *active* mode of Facebook usage), as these two modes of using one's Facebook were shown to be qualitatively different (Seidman, 2013). Based on previous studies showing that passive Facebook usage (i.e., consuming content such as photos and statuses with no actual activity; Burke et al., 2010) is correlated with social anxiety symptoms (Shaw et al., 2015), and the phenomenology of SAD implicating behavioral avoidance of (social) anxiety-provoking situations

(American Psychiatric Association, 2013; Stein & Stein, 2008), as when one needs to actively use his/her personal information, we predicated that socially anxious participants will be less willing, compared with nonanxious participants, to participate in this follow-up task, but only when required to actively use their Facebook profile page.

## Method

### PARTICIPANTS

Participants belonged to two groups: socially anxious and nonanxious undergraduate students. Three hundred and thirty-seven first-year students completed the Liebowitz Social Anxiety Scale questionnaire (LSAS; Liebowitz, 1987) at the beginning of the school year. Students with LSAS score $\geq 63$ constituted the socially anxious group ($n = 30$, 25 females, $M_{age} = 22.60$, $SD = 1.57$, *range* = 20–27). While an LSAS score > 30 is considered the clinical cutoff on this scale (Mennin et al., 2002), we set our cutoff score at 63 as this score was reported to yield no false positive identification of SAD among non-SAD individuals (Mennin et al., 2002). Hence, this cutoff score enabled the enrollment of participants that most closely resemble the clinical population of interest (Lazarov et al., 2016). The nonanxious group consisted of students with LSAS score $\leq 20$ ($n = 30$, 24 females, $M_{age} = 23.17$, $SD = 2.17$, *range* = 21–33), constituting those scoring at the bottom of the sampling pool, reflecting minimal social anxiety. Two participants (one from each group) were excluded from the eye-tracking-based analyses due to technical difficulties related to the eye-tracking apparatus during their session (i.e., no data was recorded). All participants were recruited and completed the study prior to COVID-19 outbreak. All participants provided informed consent and received course credit for participation.

The study protocol was approved by the Research Ethics Council of Tel-Aviv University and participants provided written informed consent. We only invited participants with normal or corrected-to-normal vision, excluding usage of multi-focal eyewear to prevent eye-tracking calibration difficulties. Being unfamiliar with or not using Facebook was also exclusionary.

### MEASURES

#### *Social Anxiety*

Social anxiety was measured using the self-report LSAS (Liebowitz, 1987), which lists 24 socially relevant situations, each rated in relation to the past week on two separate 0-to-3 scales, that is, level of fear and level of avoidance provoked by the described situation. Item scores are summed with a score ranging from 0 to 72 per scale, with a total score ranging from 0 to 144. Cutoffs scores of 30 for nongeneralized SAD and 60 for generalized SAD represent the best balance between specificity and sensitivity using both the clinician-administered LSAS (Mennin et al., 2002) and the self-report LSAS (Rytwinski et al., 2009), with both versions showing minimal difference on any scale or subscale score (Fresco et al., 2001). The LSAS has strong psychometric properties, including high internal consistency, strong convergent and discriminative validity and high test–retest reliability (Baker et al., 2002; Fresco et al., 2001). *Cronbach's alpha* in the present sample was 0.98.

#### *Depression*

Depression was measured using the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001), a 9-item self-report questionnaire evaluating symptoms of major depressive disorder according to the criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013). Each item corresponds to one of the nine depression symptoms, rated in relation to the previous 2 weeks. Responses range from "Not at all" (0) to "Nearly every day" (3). Item scores are summed for a total score ranging from 0 to 27. The PHQ-9 has good validity, test–retest reliability, and internal consistency (Kroenke et al., 2001). *Cronbach's alpha* in the present sample was 0.88.

#### *State Anxiety*

State anxiety was measured using the State subscale of the State Trait Anxiety Inventory (STAI; Spielberger et al., 1983). The STAI-State consists of 20 items describing current mood states, each rated on a 4-point scale ranging from 1 = "not at all" to 4 = "very much," for a total score ranging from 20 to 80. The STAI-S has strong psychometric properties, including internal consistency, convergent and discriminative validity and test–retest reliability (Spielberger & Vagg, 1984). *Cronbach's alpha* in the present sample was 0.95.

### THE FACEBOOK PROCEDURE

#### *The Facebook Task*

A fictitious Facebook profile page was created for the study (see Figure S1), including a profile picture, a birth date, personal pictures and side comments, as customary on Facebook, to make the

page look as authentic as possible. A pilot study within our lab verified its authenticity.[1] Twenty-four pictures depicting real-life situations were embedded within the Facebook page. Of those, 12 were visual illustrations of items from the LSAS questionnaire, chosen due to their visual presentation potential (LSAS items: 1, 2, 3, 6, 7, 8, 9, 15, 19, 21, 23, 24; see Table S1 for a description of each item and Figure S2a for some pictorial examples), and hence served as the social area of interest (social AOI; see below). The other 12 pictures were defined as nonsocial (i.e., socially neutral) as they did not include situations that might be deemed socially relevant, and served as the nonsocial AOI (Figure S2b). The first presented picture was neutral, followed by a social-relevant picture, with the rest presented sequentially, as customary on Facebook, following the same order. Pictures were of equal size, standardized to match normative Facebook pictures sizes. Viewing time was 3.5 minutes, during which participants freely viewed the profile page, using the computer mouse to scroll up and down at will. This viewing time was chosen based on previous research on Facebook usage (Hussain et al., 2019) and as it was found to be sufficient for scrolling all the way to the bottom of the page in another pilot verification procedure. To keep the task a passive Facebook usage task, no other actions besides scrolling were allowed (e.g., share, like, etc.).

*Subjective Uneasiness*

Subjective levels of uneasiness experienced while viewing the social-relevant pictures embedded within the Facebook page was measured using a Picture Uneasiness Questionnaire (PUQ) designed specifically for the present study. For each single picture, experienced uneasiness (i.e., "how much uneasiness do you feel") was assessed using a 100-mm Visual Analog Scale (VAS), anchored with "much uneasiness" on the right side and "no uneasiness" on the left. Participants were asked to place a vertical mark that best described the way they feel while viewing the presented picture. The VAS score was measured in millimeters from the left anchor of the scale to the subject's pen mark (Lazarov, et al., 2014). Scores ranged between 0 and 100 for each single picture, with higher scores indicating higher levels of experienced uneasiness. Total PUQ score was computed by averaging the 12 single-items VAS scores for a total score ranging from 0 to 100. Cronbach's alpha of the PUQ was 0.91.

*Eye-Tracking Measures*

Eye data was processed using Eyelink Data Viewer software (SR-research, Ottawa, Ontario, Canada). Fixations were defined as at least 100 ms of stable fixation within 1-degree visual angle (Lazarov et al., 2019). For analysis of eye data, we defined two Areas of Interest (AOIs), one including the 12 LSAS-based social pictures (i.e., the social AOI) and one including the 12 nonsocial pictures (i.e., the nonsocial AOI). Based on previous research (Lazarov et al., 2016; Lazarov et al., 2018; Lazarov et al., 2017), attention allocation was operationalized by total dwell time (sum of fixation durations) per AOI (in seconds).

## APPARATUS

Eye-tracking data was collected and recorded using the remote head-free high-speed EyeLink Portable-Duo apparatus and the recently developed WebLink screen recording software (SR-research, Ottawa, Ontario, Canada). Participants were seated approximately 700 mm away from the screen. Real-time monocular eye-tracking data were recorded continuously throughout the task at 500 Hz, with a 1920X1080-pixel display resolution.

## GENERAL PROCEDURE

Participants were tested individually in a small and quiet room at the university. They were told that they are going to participate in a study examining gaze patterns while using Facebook. After agreeing to participate and signing informed consent, participants were positioned in front of the eye-tracking monitor. First, a 5-point calibration was performed, followed by 5-point validation, providing the required reference data for computing gaze positions. The calibration procedure was repeated if visual deviation was above 0.5° on the X or Y axis for each calibration point. The experiment did not ensue until such calibration parameters were achieved. All participants were able to achieve this criterion.

Next, participants were informed that in the following 3.5 minutes their task will be to freely view someone's Facebook profile page. No additional information was given as to the person whose Facebook profile they were about to view. They were also told that during the viewing period they

[1] Twenty students, unaware of the planned study, were asked to freely inspect the Facebook profile page in a similar manner to that used in the actual study, namely, being able to scroll up and down and viewing the page for a duration of 3.5 minutes, with no eye-tracking data being collected. No additional instructions were given prior to viewing the page. Participants were then asked to indicate if they thought the Facebook profile page they just viewed was a legitimate one or a fictitious profile page, and to state the reasons for their decision. All participants, with no exceptions (100%), rated the Facebook page as being highly genuine and reliable.

will be able to scroll up and down at will, but that no other action (e.g., share, like) is allowed except for scrolling. No additional requirements, except viewing the profile Facebook page, were made. After this initial explanation, the Facebook profile page automatically appeared with eye-gaze being continuously recorded. Following the completion of the task participants were requested to fill out the PUQ and the STAI-S, and then the LSAS and PHQ-9 questionnaires. Finally, participants were asked once more to indicate their average daily usage of Facebook. All participants were thanked for participation and debriefed.

Two weeks following the completion of the free viewing task, the same participants were contacted once more over the phone to explore their willingness to participate in a follow-up two-part study for a monetary compensation per part. They were told that they could agree or refuse to participate in each of the parts separately and unrelatedly. The first part was presented as very similar to the original procedure, with the exception of freely and passively viewing their own personal Facebook profile page. The second part was presented as similar to the former, while including a requirement to share or upload personal content chosen by participants (i.e., pictures, posts, status) during the session. For each part, participants were first offered 30 NIS (~10 US dollars) for participation. If refused, the offered amount was increased to 45 NIS (~15 US dollars), and then to 60 NIS (~20 US dollars). In case of refusal to the highest amount offered, participants were asked if there is any amount for which they would agree to participate.

### DATA ANALYSIS

A sample of 60 has a power of 80% to detect a Group-by-AOI (see above) interaction of an effect size of 0.12 similar to that reported in previous studies on attention allocation in social anxiety ($\eta_p^2$ ranging from 0.12 up to 0.30; Lazarov et al., 2016; Stevens et al., 2011; Weeks et al., 2013). Hence, 30 participants per group was determined as the target sample size for this study. Power analysis was performed using G*Power 3.1.9.4 (Faul, Erdfelder, Lang, & Buchner, 2007).

Independent sample t-tests compared between-group a-priori descriptive characteristics (i.e., LSAS, PHQ-9, and daily Facebook usage time). Chi square was used for gender distribution.

To examine group differences in total dwell time on the two AOIs, we performed a mixed-model analysis of variance (ANOVA) with group (socially anxious, nonanxious) as a between-subject factor and AOI (social, nonsocial) as a within subject factor. Follow-up analysis included simple effect analysis to further explicate group differences. In addition, as groups also differed on baseline depression levels, we conducted analysis of covariance (ANCOVA) for significant findings entering depression scores from the PHQ-9 as a covariate to the above described analysis.

As the Facebook page included more "space" than that occupied by the 24 single pictures, that could also be viewed and fixated upon, we repeated the above-described analysis plan while redefining the nonsocial AOI as including the entire area of the Facebook page, excluding the 12 social pictures.

Independent sample t-tests were used to compare groups on PUQ and STAI-S scores, as well as on willingness to participate in each of the parts of the follow-up study, computed as the amount of money required by participants for participation in each part. Refusal to participate for any amount was coded as the highest amount offered (i.e., 60 NIS), which is a conservative approach for encoding this response.

All statistical tests were two-sided, using $\alpha$ of 0.05. Effect sizes for significant findings are reported using for $\eta^2_p$ for ANOVAs and *Cohen's d* for mean comparisons, including 90% effect size confidence interval (CI). In line with conventional guidelines (Olejnik & Algina, 2000), 0.01, 0.06, and 0.14 signified small, medium, and large effect sizes, respectively, for $\eta_p^2$. For *Cohen's d,* effect sizes of 0.2, 0.5, and 0.8 signified small, medium, and large effect sizes, respectively. Multiple comparisons were corrected using the Bonferroni correction. All statistical analyses were conducted with SPSS (IBM; version 25).

## Results

### DATA AVAILABILITY

The data that support the findings of this study are openly available in Open Science Foundation (OSF) at https://osf.io/nk2xv/?view_only=c2873b4bccbd4a6091775cf497acb2ff.

### DEMOGRAPHIC CHARACTERISTICS

Demographic and clinical characteristics of the two groups are described in Table 1. As expected, significant group differences emerged for LSAS and PHQ questionnaires. No differences emerged for age, gender distribution, and average daily Facebook usage (in minutes).

### CONTINUOUS GAZE ALLOCATION (TOTAL DWELL TIME)

Total mean dwell time, in seconds, by group and AOI (social and nonsocial) is presented in

Table 1
Demographic and Psychopathological Characteristics per Group

| | High SA Group | | Low SA Group | | *P* value |
|---|---|---|---|---|---|
| Measure | *M* | *SD* | *M* | *SD* | |
| Age | 22.58 | 1.59 | 23.24 | 2.17 | 0.195 |
| Gender ratio (M:W) | 5:25 | - | 5:25 | - | 1.00 |
| Facebook usage time | 50.17 | 38.39 | 41.73 | 30.59 | 0.375 |
| LSAS | 78.48 | 17.88 | 19.28 | 10.25 | <0.001 |
| PHQ-9 | 10.34 | 5.49 | 4.24 | 3.23 | <0.001 |

*Note.* SA, social anxiety; LSAS, Liebowitz Social Anxiety Scale; PHQ-9, Patient Health Questionnaire-9.

Figure 1a. As expected, a significant group-by-AOI interaction effect emerged, $F(1,56) = 7.56$, $p = .008$, $\eta_p^2 = .12$, $CI = 0.02–0.25$, indicating differential attention allocation patterns of the two groups with regard to the social and nonsocial AOIs. Follow-up simple effects analysis revealed no group difference on the social, $t(56) = 1.72$, $p = .09$, or the nonsocial AOI, $t(56) = 0.82$, $p = .41$. The group-by-AOI interaction effect remained significant after introducing PHQ-9 depression scores as a covariate, $F(1,55) = 7.28$, $p = .009$, $\eta_p^2 = .12$, $CI = 0.02–0.25$.

Total mean dwell time, in seconds, by group and AOI (social and nonsocial-all) is presented in Figure 1b. As expected, a significant group-by-AOI interaction emerged, $F(1,56) = 10.65$, $p = .002$, $\eta_p^2 = .16$, $CI = 0.04–0.30$, indicating differential attention allocation patterns of the two groups regarding the two AOIs. Separate follow-up simple effects analysis revealed that the socially anxious group spent significantly more time on the nonsocial-all AOI ($M = 104.83$, $SD = 11.16$), compared with the nonanxious group ($M = 94.49$, $SD = 8.43$), $t(56) = 3.13$, $p = .003$, *Cohen's* $d = 1.04$, $CI = 0.58–1.50$. No group difference were noted on the social AOI, $t(56) = 1.72$, $p = .09$. The group-by-AOI interaction remained significant after introducing depression score as a covariate, $F(1,55) = 11.97$, $p = .001$, $\eta_p^2 = .18$, $CI = 0.05–0.32$.

### SUBJECTIVE UNEASINESS AND STATE ANXIETY

Comparing the two groups on experienced uneasiness while looking at the social pictures (i.e., PUQ scores) revealed a significant group difference, $t(56) = 5.69$, $p < .001$, *Cohen's* $d = 1.49$, $CI = 1.00–1.97$, with socially anxious participants reporting higher levels of experienced uneasiness ($M = 30.05$, $SD = 17.42$) compared with nonanxious participants ($M = 9.31$, $SD = 9.05$). A similar pattern of results emerged for state anxiety following the Facebook task, with socially anxious participants reporting higher levels of state anxiety ($M = 43.83$, $SD = 10.41$), compared with nonanxious participants ($M = 28.76$, $SD = 6.19$), $t(56) = 5.69$, $p < .001$, *Cohen's* $d = 1.76$, $CI = 1.24–2.26$. Correlating the two measures revealed a significant positive correlation, $r = 0.69$, $p < .001$, such that increased state anxiety was associated with increased subjective uneasiness.

To examine the possible association between experienced uneasiness (i.e., PUQ scores) and attention allocation, we computed for each partic-

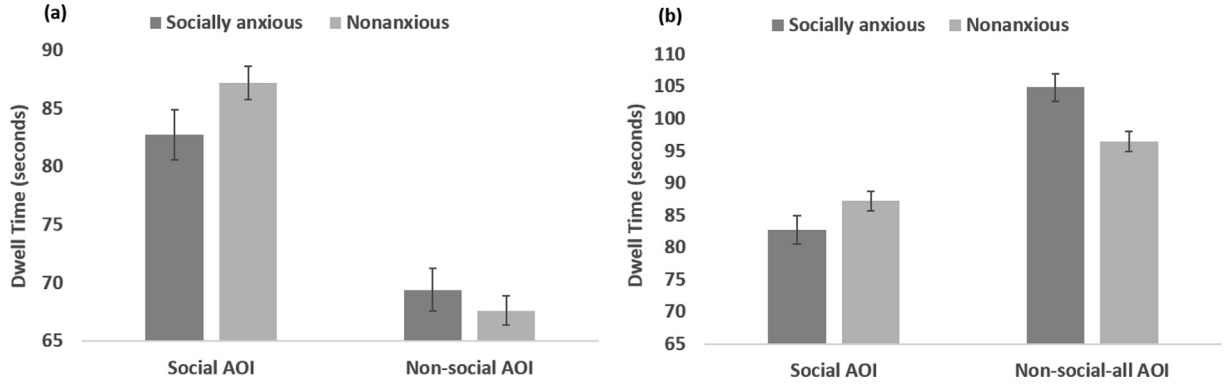


FIGURE 1 Total mean dwell times (in seconds) by Group and Area of interest (AOI). (a) Social vs. nonsocial AOIs; (b) Social vs. nonsocial-all AOIs. Error Bars denote standard error of the mean (SEM).

ipant an attention allocation score by calculating the proportion of dwell time spent on the social AOI relative to the total dwell time spent on the alternative AOI. For the social relative to the nonsocial AOI (i.e., the 12 nonsocial pictures), this was calculated by dividing the dwell time of the social AOI by dwell time of both the social and the nonsocial AOI. For the social relative to the nonsocial-all AOI (the entire Facebook page except for the 12 social pictures), this was calculated by dividing the dwell time of the social AOI by dwell time of both the social and the nonsocial-all AOI. These calculations reflect the proportion of time that gaze was fixated on social stimuli (Lazarov et al., 2017). Considering the nonsocial AOI, a significant inverse correlation emerged, $r = -0.434$, $p < .001$, in which less dwell time spent on the social AOI was associated with increased subjective uneasiness. Controlling for depression scores using a partial correlation yielded a similar significant inverse correlation, $r = -0.49$, $p < .001$. Considering the nonsocial-all AOI, a similar, albeit weaker, association emerged, $r = -0.272$, $p = .037$. Again, controlling for depression yielded a similar significant inverse correlation, $r = -0.30$, $p < .001$.

### Behavioral Avoidance (Willingness to Participate in the Additional Project)

As predicted, while no group differences emerged for participants' willingness to take part in the passive task (i.e., Part 1 of the follow-up study), $t(58) = 1.17$, $p = .25$, when requested to actively share or upload personal content (i.e., Part 2 of the follow-up study), socially anxious participants required a significantly higher payment ($M = 44.48$ NIS, $SD = 13.58$), than nonanxious participants ($M = 34.80$ NIS, $SD = 13.58$), $t(58) = 2.91$, $p = .005$, *Cohen's d* = 0.72, *CI* = 0.26–1.16.

## Discussion

In a world where social media dominates over a significant portion of social life and interactions (Hussain & Griffiths, 2018; Hussain et al., 2019), we designed an innovative exploratory study aiming to examine visual attention allocation patterns of socially anxious and nonanxious individuals as they use the most momentous social platform today, namely, Facebook. We employed a free viewing task, comprised of multiple social and nonsocial stimuli, embedded in a fictitious custom-made Facebook profile, during which we continuously recorded participants' eye data. We also assessed participants' subjective experience of uneasiness while viewing the different socially relevant pictures, as well as the actual (behavioral) willingness of participants to take part in a subsequent fictitious two-part study entailing passive and active usage of their own Facebook profiles.

Using two sets of analyses, based on two sets of AOIs, results revealed a differential attention allocation pattern of socially anxious and nonanxious participants, both reflecting avoidance of social stimuli. First, using equally sized AOIs, the socially anxious group demonstrated a viewing pattern less favoring social pictures, compared with nonanxious participants, reflecting attentional avoidance. Second, contrasting the social AOI with dwell time spent on all that *is not* one of the 12 social pictures (i.e., the nonsocial-all AOI), the socially anxious group demonstrated a viewing pattern favoring the nonsocial AOI to a higher extent, compared with nonanxious participants, once again reflecting attentional avoidance of social cues. Importantly, these findings were not affected by depression levels. The significant inverse correlation between percent dwell time on the social AOI and uneasiness scores, in both of the above-described analyses, strengthens the avoidance interpretation of our results, as the more uneasiness one felt when viewing the social pictures, the less time one spent dwelling on it. Finally, the avoidance interpretation is also suggested by group differences in state anxiety reported following the completion of the viewing task, as socially anxious participants reported more experienced anxiety, which was further positively correlated with PUQ uneasiness scores.

While present results are in line with previous eye-tracking studies showing attentional avoidance of social stimuli in social anxiety (e.g., Chen et al., 2012; Chen et al., 2015; Rubin et al., 2020; Singh et al., 2015; Weeks et al., 2013), they diverge from prior research reporting sustained attention on social threatening cues in social anxiety (e.g., Lazarov et al., 2016; Liang et al., 2017), as well as studies reporting no evidence for attentional avoidance in SAD (for a review see Bantin et al., 2016). These results may be attributed to several methodological aspects, including, among others, type of referenced stimulus used (i.e., the stimulus "compared" with the threat-related one), levels of induced situational anxiety (e.g., free-viewing vs speech task), stimulus presentation duration, severity of participants' social anxiety (Bantin et al., 2016), and the attention assessment platform, namely, reaction-time-based or eye-tracking-based paradigms (Lazarov et al., 2019).

More specifically considering the nature of the Facebook task, the divergence in results regarding avoidance might be related to the fact that here

stimuli were presented sequentially, as customary on Facebook, rather than concurrently as usually done in eye-tracking-based attentional research (e.g., Lazarov et al., 2016). Thus, as opposed to most previous eye-tracking research (for reviews, see Armstrong & Olatunji, 2012; Richards et al., 2014), in which attentional avoidance can be achieved only by diverting one's gaze away from threat stimuli and towards other less threatening regions of the visual field (i.e., neutral or positive presented stimuli or non-stimuli regions on the screen), here participants could also more actively avoid certain stimuli simply by scrolling up or down the page towards more "social-free" areas. Thus, while attentional avoidance was conceptualized via viewing patterns, it could have been also achieved via actual motor behavior (Chen et al., 2002; Heuer et al., 2007). Indeed, according to the model suggested by Clark and Wells (1995), attentional avoidance of social stimuli operates as a safety behavior. The participants in the current study were given the option to scroll up and down the Facebook page at will, enabling them to more actively deploy safety behaviors to avoid threatening stimuli simply by "scrolling them out of sight." Still, we would like to emphasize at this juncture that the avoidance pattern that emerged in the present study could not be more directly examined or situated under the vigilance-avoidance hypothesis (i.e., anxious individuals first demonstrate facilitated attention to threat and only then effortfully direct attention away from threat; Mogg et al., 2004). First, to maximize the task's authenticity, the different stimuli in the present study were presented sequentially, embedded within the Facebook page one after the other as customary on Facebook. Hence, we could not assess attentional vigilance as usually done in eye-tracking-based research in which different-valenced stimuli are presented concurrently competing over one's attention (e.g., one social-relevant and one neutral stimulus presented side by side) with groups being then compared on location or latency of initial fixations per the social and nonsocial AOIs (Lazarov et al., 2016; Lazarov et al., 2018). Second, as in traditional eye tracking tasks the different-valenced stimuli are continuously co-presented for the entire trial duration (for a review see Armstrong & Olatunji, 2012), one can divide the total presentation duration to sub-sections (i.e., analyzing a 6-seconds presentation duration as three time-bins of 2 seconds each) and examine the vigilance-avoidance hypothesis as reflected in changes in dwell time across sub-sections (Lazarov et al., 2019). However, this was not possible in the present study as stimuli were not presented concurrently on the screen throughout the procedure, but rather sequentially one after the other.

The present results also showed group differences in the actual willingness of the same participants to take part in a fictitious follow-up study, reflecting behavioral, rather than attentional, avoidance. Specifically, while, as expected, no group differences emerged for Part 1, which entailed passively viewing one's own Facebook profile page, socially anxious participants were less willing to, or more avoidant of, taking part in Part 2 that requires actively using one's own Facebook profile page (e.g., sharing or posting personal information). Thus, it seems that avoidance was not evident for any task involving Facebook usage, but only when needing to use Facebook actively. It is possible that no group differences emerged for willingness to participate in Part 1 due to either prior experience with the free-viewing task (i.e., the eye tracking task), or due to its passive nature, as participants were not required to actively share any personal information. This latter possibility is in line with previous research showing social anxiety symptoms to be related with more frequent passive Facebook usage (Shaw et al., 2015). However, when active Facebook usage was required in Part 2, anxiety possibly ascended and avoidance set in. While this interpretation seems most plausible, one cannot rule out with certainty the possibility that the unwillingness of socially anxious participants to share personal information in Part 2 was simply related to a lack in desire to do so, to not wanting to share personal content with the involved researchers, or to post it at their request, all of which are not necessarily related to actual anxious avoidance. Still, we believe that the converging evidence emanating from the present study strengthens the anxious avoidance interpretation. Future research can address this by also assessing the above-mentioned alternative explanations.

Considering the results of the free-viewing task (i.e., eye data and self-reported uneasiness) in conjunction with the results of the fictitious follow-up study might assist in clarifying some of the attentional and behavioral avoidance aspects of Facebook usage in social anxiety. First, the free-viewing Facebook task measured gaze behavior during passive Facebook usage (i.e., consuming content such as photos and statuses *with no actual activity*), with results showing no differences in willingness to take part in Part 1 of the subsequent study, also involving passive Facebook usage, but of their own profile page. Thus, when needing to passively use Facebook, either one's own page or

others, socially anxious individuals do not differ from healthy individuals, and even engage more in this behavior (Shaw et al., 2015). However, when actually doing so, socially anxious individuals tend to gaze differently at the presented information, showing more avoidance of social stimuli. The fact that no participant refused to partake in the eye-tracking task (the original Facebook task), which they could have easily done when offered to participate in the first place, strengthens this interpretation. As for active Facebook usage, while this was not assessed in the eye-tracking task, we did find that socially anxious participants were more reluctant to participate in Part 2 of the follow-up study. This finding seems to contrast with previous research indicating that social anxiety symptoms do not correlate with active usage and content production on Facebook (Shaw et al., 2015). However, Shaw et al. (2015) used a self-report measure to assess active Facebook usage, which may be subjected to response biases and wording-effects (Moskowitz, 1986; Schwarz, 1999), assuming that active usage indeed takes place. Conversely, the present study assessed the a-priori willingness of participants to take part in such an activity. Thus, assessing active usage of Facebook overlooks an important aspect of socially anxious behavior, that is, a-priori avoidance of actively using SNSs such as Facebook. Still, future eye-tracking-based research could replicate the present study while employing an active Facebook task to better elucidate visual attention allocation patterns during active Facebook usage and to better differentiate attentional from behavioral aspects of actively using Facebook.

Some limitations of the present study should be acknowledged. First, the study examined participants with high and low levels of social anxiety. Still, we used a cutoff score at 63 as an inclusion criterion, a score reported to yield no false positive identification of SAD among non-SAD individuals (Mennin et al., 2002), resulting in a socially anxious group with a mean LSAS score ($M = 78.48$) that is well within the clinical range (Mennin et al., 2002; Rytwinski et al., 2009). Moreover, administering the LSAS clinician interview to a multi-cite sample of 364 clinically diagnosed SAD patients (of those 262 meeting criteria for generalized SAD) and 34 control participants, diagnosed using a standard structured diagnostic interview, showed that the 60 cutoff score reflects the optimal balance between specificity and sensitivity in diagnosing generalized SAD (Mennin et al., 2002). Importantly, similar results emerged when using the self-report version of the LSAS (Rytwinski et al., 2009). Yet, future studies should replicate the present study among patients with clinically diagnosed SAD. Second, as the uneasiness scale (i.e., the PUQ) was designed to assess experienced uneasiness related to the socially relevant pictures, it included only the 12 LSAS-related pictures, but not the 12 nonsocial pictures. Hence, we did not assess the uneasiness that might have been felt by participants when viewing these nonsocial pictures, which might have also differed between groups. Future research using the present design should also incorporate these stimuli to improve the accuracy of present findings and better elucidate the differences in subjective experiences when viewing social and nonsocial stimuli on Facebook. Third, neither subjective uneasiness nor state anxiety were assessed prior to task administration, and hence one cannot attribute with certainty the post-task group differences to the Facebook task itself, rather than to a-priori group differences on these measures. However, we would like to emphasize that the present study was not designed to examine whether passively viewing a Facebook page would yield group differences on state anxiety/uneasiness, a prediction we did not make. Rather, it was designed to examine the differences between socially anxious and nonanxious participants in ways they view social and nonsocial stimuli on Facebook. Experienced uneasiness when viewing the social-relevant pictures was introduced to further explore possible associations with attention allocation patterns. Moreover, as these pictures were visualizations of actual LSAS items, we do not claim that groups would not have scored differently if assessed prior to task administration, as groups a-priori differed on their LSAS scores. Still, future research should also asses both measures prior to task administration to better examine the effects of the task itself. Fourth, as this study was the first to compare gaze patterns of socially anxious and nonanxious participants while using Facebook, we designed the two sets of pictorial stimuli used to differ as much as possible on their relevance to social anxiety. Hence, 12 pictures were chosen from the LSAS social anxiety scale and 12 pictures were prepared with the intent to provoke a minimum degree of social anxiety. Importantly, as items on the LSAS depict socially relevant situations, their visualized version inherently included "other people." Hence, the nonsocial pictorial set included significantly less pictures that included "other people." Thus, one might argue that we conflated images of "other people" with social anxiety imagery. However, as in social anxiety "other people" are essentially the anxiety-provoking factor (American Psychiatric Association, 2013; Stein & Stein,

2008), we do not believe this to be a major concern when considering present findings. Still, future studies may wish to replicate the present study while including a set of images that do include other people but that do not provoke social anxiety. Fifth, the Facebook eye tracking task was designed to examine gaze patterns while passively using Facebook, and hence scrolling was the only allowed action, which might limit the generalization of obtained results. Future research could replicate the present one during more active usage of Facebook to address this limitation. Finally, as the different pictures embedded within the Facebook page were presented sequentially, not concurrently as usually done in eye-tracking tasks assessing attention, the eye-tracking-based measure (i.e., total dwell time; per AOI) was computed based on the entire presentation duration of the Facebook page (3.5 minutes), with the Facebook page presentation basically serving as a "single trial." Hence, we could not calculate the internal consistency of the task, which necessitates multiple trials making up a composite score to assess a given variable. While extensive research has consistently found high reliability, both internal consistency and test–retest, for total dwell time as an attentional measure (e.g., Sears et al., 2019; Waechter et al., 2014), future research could include additional trials (i.e., several profile pages of different individuals presented consecutively) to enable computing the task's internal consistency. Relatedly, future studies can also conduct a re-test session to compute test–retest reliability.

Notwithstanding the above-mentioned limitations, the present study is the first to use eye tracking methodology to examine actual visual attention patterns among socially anxious and nonanxious individuals to social and nonsocial stimuli while using Facebook. Converging evidence suggest both attentional and behavioral avoidance of social stimuli among socially anxious individuals. As extant exposure-based therapies for social anxiety usually focus only on behaviors taking place in the "real" social world (Heimberg, 2002), we believe that present findings could be used to encourage the integration of exposure-based techniques also in the world of SNSs, from a behavioral and an attentional perspective. In a continually developing digital world, current findings serve as an initial stepping stone for the development of a wider knowledge base concerning the effects of social anxiety within SNSs and the digital world at large. The ecological qualities of the present study may mark the direction for future research aiming to explore visual attention processes in the social media realm, a more than ever relevant medium for social interaction.

### Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.beth.2020.12.007.

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