

THE EARLY DETECTION OF DEPRESSION FROM SOCIAL NETWORKING
SITES

by

Shannon E. Holleran

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by Shannon Holleran entitled The Early Detection of Depression from Social Networking Sites and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy

_____ Date: 3/24/10
Matthias Mehl

_____ Date: 3/24/10
Jeff Greenberg

_____ Date: 3/24/10
Jeff Stone

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

_____ Date: 3/24/10
Dissertation Director: Matthias Mehl

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ABSTRACT

Depression has a high prevalence among college students. Because it is a highly private (i.e. experiential) and socially stigmatized mental illness, it often goes undetected in daily life. The basic research question behind this line of research is how students' postings on their social networking websites can be used for the early detection of depression. The current research investigates how well depression can be gauged from MySpace profiles (Study 1) and Facebook profiles (Study 2 & Study 3). Across studies, the results reveal that depression can be assessed with a moderate degree of accuracy. In addition, Study 3 presents evidence that viewing "mini-blogs" allows for similar levels of accuracy compared to viewing an entire profile and the degree to which a person is Extraverted or censors information about themselves (e.g. Impression Management, Public Self-Consciousness) influences the degree of accuracy. Overall, the results speak to the idea that social networking sites can be a cost effective and clinically relevant tool to detecting depression.

Chapter 1

INTRODUCTION

In February 2009, a young man living in New York City committed suicide. He left a suicide note as a short message on Facebook.com writing that “he was born in San Francisco, became a shooting star over everywhere, and ended his life in Brooklyn...and he couldn’t have asked for more”. In the weeks and months prior to his suicide, he left similar messages such as “is wondering what unspeakable act did I do in a previous life to deserve this one?” and “is going to be the first person ever to hang himself on the way out of Portland! Everything here sucks!” Later, it was revealed that he was depressed and suffered from a substance abuse problem (Gender & Connor, 2009). After the fact, friends and family often ask themselves if there were clues to indicate if a person is depressed or suicidal, and as illustrated by the example above, social networking sites may contain important clues to identifying depression. As one can imagine, depressive symptoms are not always as obvious as in the example and should ideally be spotted long before someone commits suicide. This paper will address how well lay people can identify depression from social network sites and how depression is manifested on these sites to aid in its’ early detection.

Depression has a high prevalence among young adults. A recent survey revealed that 14.8% of college students have been diagnosed with clinical depression and that over 30% of students “feel so depressed it was difficult to function” one or more times over the course of the school year (American College Health Association, 2008). Statistics

such as these suggest that depressive symptoms are frequently experienced by college students and it is important to be able to identify depression in college students. Yet, depression is often referred to the “invisible disease” and often times goes undetected (National Institute of Mental Health, 2001).. The current studies will address the question how depression can be detected by examining one popular form of communication – social networking websites. In the last few years, social networking websites, such as Facebook.com and MySpace.com, have gained popularity among college students. In fact, 98% of University of Arizona freshmen taking introduction to psychology have Facebook.com accounts and 47% of the users log onto the site multiple times a day (Introduction to Psychology subject pool, Spring 2009).

It is possible that social networking sites provide a sense of security and belonging which allow users to disclose thoughts and feelings that are normally hidden to other people in other forms of communication. These seemingly private thoughts and feelings can then be used by other people to detect subclinical depression. Specifically, the aim of the current studies is (a) to determine how well others can detect depression from social networking sites and (b) to examine which aspects of the online environment and which individual differences moderate the accuracy of such online lay assessments of depression. In Study 1, I will examine lay assessments of depression based on MySpace.com pages. In Study 2, I will examine lay assessments of depression based on Facebook.com pages. In Study 3, I will extend Study 2’s design to examine if early signs of depression can be detected prospectively by observers. In addition, I will manipulate the information available to observers – the full profile or status updates (e.g. brief

statements of thoughts and feelings) – to determine what aspects of the online environment facilitate the accuracy of lay assessments of depression. Finally, I will test how individual differences in the targets are related to the accuracy of online lay assessments of depression.

Depression: The “Invisible” Disease

Depression is comprised of both cognitive and social components (Barnett & Gotlib, 1988; Coyne & Gotlib, 1983; Haaga, Dyck, & Ernst, 1991; Monroe & Reid, 2009). Most clinical theories of depression suggest that depression is primarily manifested in thoughts and feelings about the self (e.g. Beck, 1967). Accordingly, in the DSM-IV, six out of nine core symptoms of depression are primarily experiential and thus not directly observable (e.g., depressed mood, feelings of worthlessness and guilt, thoughts of death, fatigue) and only three are primarily behavioral in nature and thus potentially directly observable (e.g., weight loss or gain, in- or hypersomnia, psychomotor agitation or retardation).

This suggests that depression is not easily noticed by outside observers – much less by close others who are not trained as clinicians. That is, on the outside, it may be difficult to distinguish depressed individuals from their non-depressed counterparts based on their behavior. Empirically, this is supported by research on the social interactions of depressed individuals which finds that, counter to the notion of the socially isolated depressed person, depressed people do not engage in fewer social interactions (e.g. spending less time with friends, more time alone) than non-depressed individuals (Mehl, 2006; Nezlek, Hampton, & Shean, 2000; Nezlek, Imbrie, & Shean, 1994). Rather than the

quantity, it is the quality or subjective interpretation of the social interactions (i.e., the cognitive component) in which depressed and non-depressed individuals differ. Most importantly--and maybe not surprisingly--depressed individuals experience lower levels of enjoyment and intimacy in social interactions compared to non-depressed individuals (Nezlek et al., 2000).

However, these findings do not assume that the negative interpretations of interactions of depressed individuals never “leak out” into social behavior. Depressed individuals’ sadness evokes anger in their interaction partners which often results in a great deal of rejection from others (Coyne, 1976). Accordingly, research finds that people interacting with depressed individuals find the overall experience negative and irritating as a result of, for example, that excessive reassurance seeking that depressed individuals tend to engage in (Amsutz & Kaplan, 1987; Elliot, MacNair, Herrick, Yoder, & Bryne, 1991; Gurtman, 1987; Segrin & Dillard, 1992).

Depressed individuals can be alienated by other people, suggesting that their interaction partners identify that the anger and reassurance seeking in their behavior as abnormal. This idea lends itself to the empirical question of whether depression can be detected from daily behavior. In a study testing this idea, strangers rated how depressed a group of unacquainted targets were based on a representative sample of two days of their social lives. Witnessing a person’s actual, real-world interactions across a variety of settings from more than 100 brief snippets of ambient sounds is information that is quite similar to what a person’s friends usually have available (Mehl, 2006). Despite an abundance of rather personal information about the targets, namely their naturally-

occurring social interactions and activities, though, the strangers were no more accurate than chance in estimating the targets' levels of depression. The correlation between the raters' perceptions of the targets' levels of depression and the targets' number of endorsed depressive symptoms (i.e. BDI scores) was $r = .13$ and not statistically different from zero. These findings are in line with prior research on the lack of differences in social behavior of depressed and non-depressed individuals (e.g. Nezlek et al., 2000). Together, this suggests that depression is invisible to others and people may even actively hide it from their friends.

Depression might appear to be invisible to others. Trait depression, the trait analog to clinical depression, is a highly evaluative trait, that is, a trait which people do not readily endorse in describing themselves to others (John & Robins, 1993). Highly evaluative traits tend to be harder to detect in other people (Holleran & Mehl, 2010) presumably because people censor their actual standing on that particular trait. Research on impression management suggests that this occurs because people attempt to regulate how they are seen by others (Paulhus & Trapnell, 2008). Impression management processes are particularly prevalent in public contexts and this might be one reason why depression, in public contexts such as actual, face-to-face interactions, may be hard to detect in others.

We suggest that contextual variables, such as the degree to which a context is private or public, might influence whether depression is expressed to others. This is supported by a set of studies examining how depression is detected from different kinds of writing samples. In these studies, we attempted to gradually reduce the degree of

privacy from study to study to see whether the accuracy levels also drop accordingly. Given that depression is primarily manifested in thoughts and feelings, one study had strangers gauge depression from stream of consciousness essays which tracked momentary thoughts over the course of 20 minutes—arguably one of the highest possible levels of privacy (Holleran & Mehl, 2008). Consistent with the idea that impression management processes are less prevalent in private contexts and that people are therefore more willing to disclose depression-related thoughts and feelings, strangers were able to judge depression with a substantial degree of accuracy ($r = .44$). This suggests that highly private information can provide good information for judging depression.

However, it would be hard for other people to detect depression if depression is exclusively manifested in internal thoughts and feelings as those are naturally not accessible to other people. A context that is in important ways similar to momentary thoughts and feelings, but somewhat less private, is a written diary. In the absence of an ability to mind read, a person's thoughts and feelings are inaccessible to others. Written diaries, on the other hand, are also inherently private yet can at least in theory be shared with others. Theoretically, this might increase the degree of impression management or censoring that the writing is subjected to, but likely considerably less than what would be expected of writing which is explicitly directed toward other people. As such, it would be expected that depression can be gauged by strangers' in semi-private writing contexts.

This is supported by evidence in a prior study in which strangers read students' written diaries about coming to college (Holleran, Mason, Robbins, & Mehl, 2010). The degree of accuracy achieved by strangers in this study was similar to the degree of

accuracy using stream of consciousness essays ($r = .51$). Finally, further support the idea that private contexts provide good information to gauge depression is provided by an experimental study which used a within-person manipulation to examine if depression can be assessed in a private context (i.e. simulated personal diaries) or a more public context (i.e. simulated online blogs; Rodriguez, Holleran, & Mehl, in press). Replicating our prior research (Holleran & Mehl, 2007; Holleran et al., 2010), the accuracy of lay assessments of depression was substantial in the personal diary condition ($r = .49$). Interestingly, though, the positive finding for accuracy also extended to the public writing condition – participants’ simulated online blogs yielded an accuracy correlation of $r = .56$. This raises the possibility that despite the fact that online blog interactions are ultimately public in nature, people might engage in less impression management when interacting through online blogs than when interacting face-to-face with another person and therefore reveal more of their private selves (Mehl, 2006).

Overall, this set of findings suggests that depression can be gauged rather well in private contexts which tend to be low in impression management. However, the study using simulated blogs suggests that depression may also be gauged rather well in certain public contexts (Rodriguez et al., in press). The current studies examine the generalizability of this experimental, lab-based finding to parallel real-world phenomena by investigating the accuracy of lay assessments of depression from blogs on social networking sites.

Using Social Networking Sites to Detect Depression

Over the last decade, the number of people using social networking sites has substantially increased. In 2008, 691 million people visited social networking sites with Facebook and MySpace ranking number 1 and 2 with 200 million and 126 million users, respectively (TechCrunch, 2009). Statistics such as these suggest that social network sites have become an integral part of people's everyday social lives and have emerged as one of the main forms of communication among certain social groups.

I argue that social networking sites provide a sense of security and belonging which is unique to this type of communication. First, social networking sites provide a sense of security to disclose thoughts and feelings freely (often without censoring) to a network of people who can choose to intake the information or not. Unlike face-to-face interactions in an in-person dyadic or group setting where information is directed immediately at specific people, information available on social network sites do not have to be immediately attended to by the targeted group of friends. Information is available on a person's profile, but friends can look at it at their leisure. The information posted on social networking profiles also reach a larger audience compared to a typical in-person interaction, thus increasing the size of the social network. In essence, people do not have to be concerned with immediate feedback in response to what has been written without feeling as if they are "forcing" other people to listen to their problems.

Another way that psychological security is provided is through the perception of control that social networking sites provide. Users are able to limit who sees information through various privacy settings on the sites which allow certain audiences (e.g. friends from school, childhood friends, work colleagues, family) to view certain parts of a

person's profile. Additionally, users are able to modify any part of their profile (e.g. pictures) or written communication on the profile at any time. This allows users to rescind or "take back" anything that they wrote at any point by simply erasing it as if it never happened - which is harder to do in face-to-face interactions. In turn, this may allow users to more freely express what they actually think and feel which is supported by recent research suggesting that tend to portray an accurate representation of their actual personality rather than an idealized representation of their desired personality on social networking sites (Back et al., in press).

Social networking sites also create a sense of belonging to a larger community. The need to belong is a--or some would say the--basic human need (Maslow, 1954; Baumeister & Leary, 1995). It may be a recent phenomenon but people now routinely attend to social networking sites for regulating this need (Pickett, Gardner, & Knowles, 2004). One of the main purposes of these sites is to facilitate social connections (e.g. through adding "friends") and allow people to keep in touch with each other (e.g. through browsing other people's profiles to catch up on events in their lives). When users post information or updates about themselves, several social networking sites have the feature which allows friends to comment on the information. When users receive comments, it evokes a sense of belonging because one of their friends read the information they posted and acknowledge it through a short phrase for the rest of a user's friends to see.

I argue that psychological security and belonging can be evoked from using social networking sites and this may have implications for the ability to detect depression. On one hand, the information posted on social networking sites is available to other people

which may prime impression management concerns that can undermine accurate lay assessments of depression. Alternatively, social networking sites may provide a sense of psychological security and belonging and thereby create a semi-private context that then, in turn, limits impression management concerns. In this case, social networking sites would provide good contexts from which laypersons can detect depression.

Overview of Studies

Broadly, the two aims of the current studies were to (a) determine how well depression can be gauged from social networking sites and (b) to examine which aspects of the online environment and what individual difference variables on the side of the users moderate accurate lay assessments of depression. To investigate the first aim, I examined the accuracy of assessments of depression from MySpace.com pages (Study 1) and Facebook.com pages (Study 2). To investigate the second aim, I manipulated aspects of the online environment of Facebook pages and tested the degree to which individual differences related to impression management concerns (i.e. Extraversion, dispositional impression management, public self-consciousness) might influence the accuracy of online lay assessments of depression (Study 3).

Chapter 2

STUDY 1: THE DETECTION OF SUBCLINICAL DEPRESSION FROM MYSPACE

In Study 1, we examined whether depression can be gauged from one popular social networking website – MySpace.com. Prior literature on the accuracy of lay assessments of depression (Holleran & Mehl, 2007; Holleran et al., 2010; Rodriguez et al., in press), has found substantial levels of accuracy (r 's = .41-56). However, these previous studies were conducted in controlled laboratory environments and with contexts that tend to be more private than MySpace pages. Since Myspace pages tend to be more public in nature, we expected there to be a greater impression management concerns which might limit the availability of depression-relevant thoughts and feelings. However, one of the main features of MySpace pages are blogs which should provide a context in which thoughts and feelings are readily expressed. Taking this into consideration, we predicted that assessments of depression would achieve a moderate level of accuracy, but the level of accuracy might not be as large as prior research.

Method

Participants

204 participants recruited from MySpace served as target participants. 121 (59%) were female. Of the 204 targets that provided their ethnicity, 156 (76%) identified themselves as white, 20 (10%) as Latino/a, 11 (5%) as Asian, 5 (2%) as Native American, 3 (1%) as African American and 8 (4%) as other. The targets ranged in age

from 15 to 58 ($M = 25.6$, $SD = 6.56$). 7 female undergraduate research assistants served as naïve raters.

Phase One: Target Assessment of Depression

Target participants were recruited through MySpace using MySpace bulletins where information about the study was posted (e.g., contact information for the researchers) and the built-in search engine on MySpace. All of the targets recruited through the search engine were alumni or current students of the University of Arizona. Each target participant was contacted with information about the study. After the target participant agreed to participate, they were emailed a link to the online questionnaires. The Beck Depression Inventory (BDI; Beck, Ward, & Mendelson, 1961) was included within a larger set of questionnaires ($M = 6.96$; $SD = 5.7$, range: 0 to 35). Using a consensual BDI cut-off score of 13 for mild depression, 13.2% of the sample were at least mildly depressed (Lasa, Ayuso-Mateos, Vázquez-Barquero, Díez-Manrique, & Dowrick, 2000). After target participants agreed to participate, their page was downloaded and saved.

Phase Two: Ratings of Target Depression

Judges examined each MySpace page and formed a first impression based on the information available from the saved pages. An “average” page contains a profile picture at the top of the page and includes a profile name (which is usually a nickname) and a headline (a short phrase). There is also an About Me section that individuals use to write about themselves, usually in paragraph form. Users also have the option to list favorite music, movies, television, books, and heroes. Under that section, there is an area where

they can provide their relationship status, sexual orientation, hometown, body type (height and build), ethnicity, religion, zodiac sign, smoker/drinker, children, education and their companies (places of employment). To the right of this section are the individual's top ranked friends (known as 'Top Friends') and their total number of friends. Lastly, under this section of the profile, comments where others leave messages can be seen by others (e.g., "umm..soo you're pretty much amazing," "I missed my first 2 college classes today..I got lost... Opppps.."). Each comment is time and date stamped and the 50 most recent are available on the user's page along with a count of the total number of comments. Users can also add music, videos, stickers and other designs in addition to changing the background of the profile page. There is also a page where users can blog about themselves. This page allows users to provide the title and subject of their post, the date and time of their post, in addition to their mood and what they are doing at the time (e.g., reading, listening to music, etc.). Users can also post pictures on their page and categorize them according to different albums that are titled (e.g., Vegas Trip).

Judges had access to all of this information for rating the target participants' depression. Their ratings were based on the single-item depression measure "I see the target as someone who is depressed" based on a one (strongly disagree) to seven (strongly agree) point scale.

Phase Three: Cue Validity and Cue Utilization Analysis

Brunswik's (1956) lens model provides a framework to examine the relationship between linguistic cues in the MySpace blogs, judges' perceptions of depression, and targets' actual levels of depression. In lens model terms, "cue utilization" refers to the

correspondence between the observable cue (e.g. use of sadness words) and judges' perceptions of the targets' standing on the trait or construct (i.e. perceived depression). "Cue validity" refers to the correspondence between observable cues (e.g. use of sadness words) and targets' actual position on the given trait or construct (e.g. self-reported depressive symptoms).

To evaluate cue utilization and cue validity within a lens model framework, the targets' essays were submitted to Linguistic Inquiry and Word Count (LIWC; Pennebaker, et al., 2001), a text analysis program that provides computerized word counts for psychologically-based linguistic categories. Following the procedure adopted by Rodriguez et al. (2010), from the 74 LIWC variables, 18 were selected for their theoretical relevance to assessing depression (Rude, et al. 2004; Pennebaker, et al., 2003). These variables included positive (e.g. happy, good) and negative (e.g. sad, worthless) emotion words, cognitive mechanism words (e.g. know, think, ought), first person singular pronouns (e.g. I, me), and past tense verbs (e.g. were, had) (see complete list in Table 2) which were aligned with five psychological processes (emotional, cognitive, temporal, social, and personal concerns; Cohn, et al, 2004; Lyons, et al., 2006). Together, these cues provided information about both the thematic content and the linguistic style of the blogs.

Results

How accurate were the judges' lay assessments of subclinical depression from MySpace pages?

Accuracy correlation. The ratings on the one item depression measure were averaged across all 7 judges to create a composite measure of judged depression. The level of agreement among the judges was .73 (using an intra-class correlation [ICC 2,k]; Shrout & Fleiss, 1979). The composite of judges' ratings of depression was correlated with targets' score on the BDI to serve as the accuracy criterion. The accuracy correlation between judges' ratings and targets' level of depression was .24 ($p < .001$).

Signal detection analysis. A signal detection analysis was conducted as another test of how accurate judges could perceive depression. Targets were divided into two groups: non-depressed (BDI scores under 13) and mildly depressed and above (BDI scores 13 and above). Judgments of depression were divided into 2 groups: judgments of being not depressed (below 4 on the 1 to 7 rating scale) and judgments of depression (4 – neither agree nor disagree – or above on the rating scale). This analysis shows the percentage of targets who fell under four different conditions: how good judges are at detecting the presence of depression among targets who are depressed (i.e. sensitivity), how good judges are at detecting the absence of depression among targets who are not depressed (i.e. specificity), how likely it is that a target who the judges identified as depressed is actually depressed (i.e. positive predictive value), how likely it is that a target who the judges identified as non-depressed is actually non-depressed (i.e. negative predictive value). Table 1 displays the raw number of targets that fell under each condition as well as the percentage for each condition (i.e. sensitivity, specificity, positive predictive value, negative predictive value). The results reveal that lay assessments of

Table 1

Signal detection analysis for Study 1.

	Targets who were judged as depressed	Targets who were judged as not depressed	
Targets who were at least mildly depressed	2 (TP)	25 (FN)	Sensitivity = 7.4%
Targets who were not depressed	9 (FP)	168 (TN)	Specificity = 94.9%
	Positive predictive value = 18.1%	Negative predictive value = 87%	

Note. TP = true positive, FP = false positive, TN = true negative, FN = false negative; BDI cut-off for mild depression is 13; cut-off for judges' ratings in response to the item "I see the target as someone who is depressed" was 4 (neither agree nor disagree) on a 1 (strongly disagree) to 7 (strongly agree) scale.

depression from MySpace profiles have high negative predictive value and specificity but low sensitivity and positive predictive value.

Discussion

The results from Study 1 suggest that subclinical depression can be gauged from MySpace pages with a significant degree of accuracy. The effect size of the accuracy correlation was medium-sized (Cohen, 1992) and is consistent with meta-analytic evidence on the accuracy of personality judgments¹ (Holleran & Mehl, 2010). Although judges achieved a moderate level of accuracy, the level of accuracy was lower than accuracy achieved previous experimental research.

¹The meta-analytic accuracy correlations are: .35 for Extraversion, .24 for Openness, .21 for Conscientiousness, .15 for Emotional Stability, and .13 for Agreeableness (Holleran & Mehl, 2010).

One reason for the smaller effect size might be the lower degree of control in naturalistic settings. The lab findings were conducted in a controlled environment and the information that judges had available was strictly limited to writing samples. With the MySpace pages, there was a host of information available to judges besides writing samples. Although MySpace blogs and self-descriptions were crucial components of the information that was available to judges, they also had access to pictures, comments made by friends, and the general differences in the layout of the pages (i.e. background colors and designs). One difference between this study and prior research on the accuracy of assessments of depression is the availability of physical appearance information. Judges most likely took this information into consideration when making their assessments. This information might provide misleading information because depressed people do not try to look – or act – depressed (Mehl, 2006; Nezlek et al. 2000). It is also possible--and ultimately likely--that judges also used social network information (e.g. the number of friends, written interactions with friends) in their assessments of the targets' levels of depression. Follow-up analyses revealed that the number of friends was unrelated to targets' levels of depression ($r = .01, p = .90$) and the number of written interactions with their friends ($r = -.01, p = .94$). This suggests that this information is misleading to gauging depression² and is consistent though with the research showing that both depressed and non-depressed individuals do not differ in the quantity of their social interactions (Mehl, 2006; Nezlek et al., 2000).

² Follow-up analyses revealed, however, that the number of friends and number of written interactions did not correspond to judges' ratings of depression ($r = -.01, p = .93$ for number of friends, $r = .08, p = .28$ for number of interactions).

Having more information available to judges could result in a dilution effect of the depression ratings (Nisbett, Zukier, & Lemley, 1981). Dilution effects occur when the presence of non-diagnostic information (e.g. number of friends, written interactions) results in less extreme judgments of depression. Essentially, non-diagnostic information makes raters take *actual* diagnostic information less into account when rating depression. This suggests that symptoms of depression present on the pages could be masked by all the other non-diagnostic information. Follow-up analyses revealed that the language use in MySpace blogs was related to depression. Table 2 displays the cue validity correlations (correspondence between the language use and targets' depression) and the cue utilization correlations (correspondence between the language use and judges' ratings of depression) based on prior research on language use and depression (Rodriguez et al., 2010). Many of the language cues were unrelated to depression. However, people who were depressed used less positive emotion words (e.g. happy, good; $r = -.19, p = .03$) and more death-related words (e.g. dead, burial; $r = .23, p = .01$). It is possible that raters did not judge individuals' as being depressed because there was a lot of information on the MySpace pages which pointed toward signs of non-depression. However, despite all of this potentially misleading information, judges still achieved a moderate degree of accuracy.

Theoretically, these findings are consistent with the idea that social networking sites constitute semi-private contexts and allow for aspects of depression to be manifested. According to the DSM, depression is particularly manifested in cognitive aspects and interpretations about the self (e.g. worthlessness, tiredness). If social

Table 2
Lens model analysis of judges' lay assessments of depression for MySpace blogs (Study 1):
Correlations between the LIWC-derived cues and judges' ratings of targets' depression (cue utilization) and the targets' self-ratings of depressive symptoms (cue validity).

LIWC-derived cues	Example word	Cue validity (<i>r</i>)	Cue utilization (<i>r</i>)
<i>Emotional processes</i>			
Positive emotion words	Happy	-.19*	-.06
Negative emotion words	Worthless	.00	-.02
Sadness words	Cry	-.05	.01
Swear words	Damn	.01	-.03
<i>Cognitive processes</i>			
Cognitive mechanism words	Cause	-.05	.23*
Causation words	Because	-.05	.30**
Insight words	Think	-.08	.19*
Inhibition words	Constrain	-.03	.20*
<i>Temporal processes</i>			
Past tense verbs	Were	.18*	.16
Present tense verbs	Be	-.13	.05
Future tense verbs	Will	.07	.01
<i>Social processes</i>			
Social words	Friend	-.02	.01
1 st person singular pronouns	I	.00	.14
1 st person plural pronouns	We	.06	-.11
<i>Personal concerns</i>			
Metaphysical words	Coffin	.13	.02
Religion words	God	.07	-.04
Death words	Dead	.23*	.22*
Sleep words	Asleep	.01	-.03

Note. *N* = 118 for targets; *N* = 7 for judges. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC – Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

networking sites allow for accurate assessments of depression, the more that social network sites contain self-relevant information, the easier it might be to detect

depression. One recent feature of social networking sites is “status updates” which promotes “mini-blogging”. Status updates allow users to declare to their friends their current thoughts and feelings which might be particularly beneficial in assessing depression.

Chapter 3

STUDY 2: THE DETECTION OF DEPRESSION FROM FACEBOOK

In Study 2, we examined assessments of subclinical depression using another popular social networking site – Facebook.com. Facebook allows users to “mini-blog”, or update their current status, as often as they desire. Because status updates record a person’s thoughts and feelings, we expect that Facebook pages will allow for accurate assessments of subclinical depression. We expect that the accuracy correlations will slightly higher to those found in Study 1.

Method

Participants

126 psychology students who had Facebook pages served as target participants. 84 (67%) were female. 85 participants (68%) identified themselves as white, 18 (14%) as Latino/a, 11 (9%) as Asian, 2 (2%) as Native American, 6 (5%) as African American and 4 (3%) as other. The targets ranged in age from 18 to 24 ($M = 18.8$, $SD = .98$). 5 (3 female) undergraduate research assistants served as naïve raters.

Phase One: Target Assessment of Depression

Target participants were recruited through the introduction to psychology subject pool. Each target participant completed the BDI as part of a larger set of personality questionnaires. In this sample, the mean BDI score was 9.10 ($SD = 6.75$, range = 0 to 31). Using the consensual BDI cut-off score of 13 for mild depression, 30 (21.4%) of our sample were at least mildly depressed (Lasa et al., 2000). Each target participant then

downloaded and saved a copy of their Facebook page. Activity on the main part of the page (e.g. the “wall”) was saved retrospectively from 3 months prior to completing the questionnaires. Three other sections of the page (in addition to the wall) were saved: the information section which lists likes/dislikes, short self-descriptions, and basic information; the main photo page which lists the number of albums and a few pictures; the boxes section which lists the applications (e.g. bumper stickers, catbook/dogbook) the user has on their page.

Phase Two: Ratings of Target Depression

Each judge was asked to form a first impression of the target based on their entire Facebook page. The judges had access to all four sections of the profile that were downloaded and saved by the target participants. For the wall section of the page, judges were told to read the comments and status updates in chronological order. After judges examined all four sections of the page, they completed a questionnaire based on their first impression. The judges’ ratings of depression were based on the single-item “I see the target as someone who is depressed” based on a one (strongly disagree) to seven (strongly agree) point scale.

Phase Three: Cue Validity and Cue Utilization Analyses

Similar to Study 1, the linguistic cues in the status updates related to depression were correlated with targets’ level of depression and judges’ lay assessments of depression. Additionally, two independent research assistants also coded the status updates for 8 indicators of depressive symptomology based on the criteria determined by the DSM IV. (e.g. sadness, loss of interest, fatigue, feeling sick; overall $\alpha=.94$).

Examples of status updates containing depressive symptoms include “I can’t concentrate on this assignment,” “I am so bored,” “Not sure what to do.” To examine cognitive and experiential aspects of depression, two composite categories were created. The symptoms that fell into the cognitive category ($\alpha = .63$) were feeling sad, loss of interest in activities, feelings of worthlessness, inability to concentrate, and thoughts of death, while symptoms of increase/decrease in appetite, insomnia/hypersomnia, and feeling sick fell into the experiential category ($\alpha = .66$).

Results

How accurate were the judges’ lay assessments of subclinical depression from Facebook pages?

Accuracy. The ratings on the one item depression measure were averaged across all 5 judges to create a composite measure of judged depression. The level of agreement among the judges was .69 (using an intra-class correlation [ICC 2,k]; Shrout & Fleiss, 1979). The composite of judges’ ratings of depression was correlated with targets’ score on the BDI to serve as accuracy criterion. The accuracy correlation between judges’ ratings and targets’ level of depression measured by the BDI was .12 ($p = .18$).

Signal detection analysis. Identical to the procedure in Study 1, a signal detection analysis was conducted to determine the levels of specificity, sensitivity, positive predictive value, and negative predictive value. The results are displayed in Table 3. The results revealed that the sensitivity and positive predictive value are 0% for this study because judges rated none of the participants as being depressed who were actually depressed. In fact, the results reveal that judges only rated 3 participants above 4 on the 1

Table 3
Signal detection analysis for Study 2.

	Targets who were judged as depressed	Targets who were judged as not depressed	
Targets who were at least mildly depressed	0 (TP)	31 (FN)	Sensitivity = 0%
Targets who were not depressed	3 (FP)	93 (TN)	Specificity = 97.9%
	Positive predictive value = 0%	Negative predictive value = 75%	

Note. TP = true positive, FP = false positive, TN = true negative, FN = false negative; BDI cut-off for mild depression is 13; cut-off for judges' ratings in response to the item "I see the target as someone who is depressed" was 4 (neither agree nor disagree) on a 1 (strongly disagree) to 7 (strongly agree) scale.

(not at all depressed) to 7 (extremely depressed) scale. So, parallel to the MySpace findings from Study 1, lay assessments of depression from Facebook profiles have high specificity and negative predictive value, but fail to show good accuracy at identifying actually depressed targets.

What aspects of the Facebook pages are related to subclinical depression and which cues do judges use in making their assessments?

Consistent with Study 1, neither the number of friends ($r = -.01, p = .96$) nor the number of written interactions ($r = .03, p = .71$) was related to targets' level of depression. Table 4 displays the cue validity and cue utilization correlations for the same language categories as Study 1. Instead of analyzing the blogs, the status updates were linguistically analyzed because no blogs were present on the Facebook pages.

Table 4

Lens model analysis of judges' lay assessments of depression for Facebook status updates (Study 2): Correlations between the LIWC-derived cues and judges' ratings of targets' depression (cue utilization) and the targets' self-ratings of depressive symptoms (cue validity).

LIWC-derived cues	Example word	Cue validity	Cue utilization
<i>Emotional processes</i>			
Positive emotion words	happy	-.08	-.08
Negative emotion words	worthless	.01	.41*
Sadness words	cry	-.01	.18*
Swear words	damn	.05	.04
<i>Cognitive processes</i>			
Cognitive mechanism words	cause	.12	.17
Causation words	because	.04	-.11
Insight words	think	.08	.15
Inhibition words	constrain	.04	.13
<i>Temporal processes</i>			
Past tense verbs	were	.09	-.07
Present tense verbs	be	.00	.05
Future tense verbs	will	.08	.09
<i>Social processes</i>			
Social words	friend	-.02	-.04
1 st person singular pronouns	I	-.13	-.16
1 st person plural pronouns	we	-.12	-.01
<i>Personal concerns</i>			
Metaphysical words	coffin	-.05	.01
Religion words	God	-.04	-.01
Death words	dead	-.03	.02
Sleep words	asleep	.01	.26*
<i>Depressive symptoms</i>			
Total number of symptoms		.05	.59**
Experiential symptoms		.04	.67**
Behavioral symptoms		.09	.37**

Note. $N = 119$ for targets; $N = 5$ for judges. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC = Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

Inconsistent with Study 1, using positive emotion words ($r = -.08$, $p = .40$) and death-

related words ($r = -.03$, $p = .78$) in status updates were unrelated to depression.

Table 4 also displays the cue validity/use correlations for depressive symptomology in the status updates. The total number of depressive symptoms, experiential symptoms (e.g. feels sad, loss of interest, hard to concentrate, feelings of worthlessness, death-related thoughts) and behavioral symptoms (e.g. feeling sick, fatigue, insomnia/hypersomnia, loss of appetite) are presented in the table. None of the depressive symptoms were valid cues of depression although raters used them in making their judgments.

Discussion

The results from Study 2 suggest that depression is harder to judge from Facebook pages than from MySpace pages. In fact, the accuracy of judges' lay assessments of subclinical depression in this study did not exceed chance levels. Compared to prior research, the accuracy correlations are more similar to assessments of depression based on social interactions (Mehl, 2006). This suggests that the information contained on Facebook pages may, in fact, be more similar to the information that real face-to-face social interactions provide than to the information contained on MySpace pages.

Although MySpace and Facebook are both social networking sites, systematic differences exist between the two sites. MySpace has a large degree of profile customizations available to users which allows them to upload videos, pictures, and graphics directly to their profile page. This allows users to creatively express themselves, thus consistent with the name of the site, create their own personal(ized) space on the

web. In contrast, Facebook has a standardized profile page layout and the background is consistent across users. The higher level of personal expression on MySpace pages might partially account for the higher levels of accuracy – which would be consistent with research finding high levels of accuracy for personality traits from personal websites—that are individually created from scratch (Marcus et al., 2006; Vazire & Gosling, 2004).

One of the most widely used features on MySpace is the blogging feature and consistent with traditional blogging websites, includes a tab on the profiles which redirects to users' blog and allows them to sign up to receive notifications when blogs are updated. Facebook offers a blogging feature which allows users to leave “notes”, but much of the blogging activity on the Facebook pages is via status updates. Although the design of Facebook notes is to function like a blog, very few of the participants left “blog-like” postings. Much of the notes focused on news stories that users wished to alert to their friends. Thus, these profiles contained few places for users to post extended accounts of their thoughts and feelings.

Instead, status updates dominated the profiles. Status updates allow for spontaneous, momentary thoughts and feelings that can be tracked across time. Status updates are quick statements (usually less than 160 characters) which are written without much thought and often on-the-go (with many cell phones having applications to post status updates). Blogs, on the other hand, are often elaborate well-thought descriptions which are constructed over a longer period of time. Similar to the phenomenon of “non-verbal” leakage (DePaulo, 1992; Ekman & Friesen, 1969), information posted on status updates could reflect a process which is difficult to control. Non-verbal leakage occurs

when a person's behavior reflects their genuine feelings or attitudes even in the face of attempts at the conscious control of social impressions. That is, people try to censor their true feelings somewhat unsuccessfully especially when they are making an impression. Compared to traditional blogs, status updates could contain greater "thought leakage" because they are spontaneous, written without much thought or elaboration, and written on-the-go. Status updates are updated as often as several times a day, so depressive symptomology might be harder to constantly control and censor, thus making it easier to judge depression.

However, in this study, judges did not accurately perceive depression even when they had access to status updates. One explanation for the lack of effect is the dilution effect of having information that is non-diagnostic of depression in the profiles (Nisbett, Zukier, & Lemley, 1981). The results of this study revealed that none of the social networking cues or language use in the status updates was related to depression – thus making this all non-diagnostic information.

The lower levels of accuracy could also be accounted for by the more public nature of Facebook pages compared to MySpace pages. One feature on Facebook is the "news feed" which broadcasts status updates, comments, and various changes to profiles on the home page of the website. Whenever a user logs onto the site, they see the recent activity of members in their social network. Psychologically, this makes the information posted on Facebook more publically accessible and might increase impression management concerns. In this sense, Facebook functions similarly to other daily social interactions and the low levels of accuracy reflect this similarity.

On the surface, it may seem that Facebook is not a good context to gauge depression. Popularity for Facebook has steadily increased and surpassed MySpace (Tech Crunchies, 2009). Practically, it is important to understand how (and if) depression is manifested in this context. The findings might be due to methodological artifacts such when the targets pages were saved (near the end of the semester) or when the ratings were conducted (during the summer). The third study will examine if these findings are replicated. The findings of Study 2 also might suggest that depression might be gauged from Facebook only under certain conditions. Study 3 will experimentally test the moderating effects of different environmental contexts and individual differences moderators which we theorize will result in greater accuracy for depression.

Chapter 4

STUDY 3: USING FACEBOOK TO TEST MODERATORS OF ACCURACY

Overall, the results from Study 2 suggest that it can be difficult for laypersons to assess depression from Facebook pages. In Study 3, I tested two different types of moderators to test whether depression can be assessed under certain conditions: environmental moderators and individual difference moderators.

To test the environmental moderators, I manipulated the type of information available to judges. Prior research finds that the social network of depressed individuals does not differ from non-depressed individuals (suggesting that this is not valid information to gauge depression; Mehl, 2006; Nezlek et al., 2000). It is possible that judges gave social network information too much weight in making their assessments of depression – which is one possible explanation of why judges achieved substantially higher levels of accuracy in studies where no social network information was available (Holleran & Mehl, 2007; Holleran et al., 2009; Rodriguez et al., in press). This would be consistent with a dilution effect. Thus, limiting the amount of information which is non-diagnostic should result in greater levels of accuracy.

Furthermore, cognitive theories of depression and the DSM suggest that depression should be manifested in thoughts and feelings. On Facebook pages, status updates are one component of the pages which reveal thoughts and feelings. Since status updates are comprised of spontaneous, momentary thoughts and feelings, I expect that they evoke a lower degree of impression management. Similar to the idea of leakage of

expressive behavior (DePaulo, 1992; Ekman & Friesen, 1969), I expect that status updates will contain signs of depression because they occur often, co-occur with other events, and are posted without a great deal of thought.

The other information on the page is related to social networking (e.g. posted pictures of hanging out with friends) which I theorize are pieces of information where there is a high degree of impression management. Based on the results of Study 1 and Study 2, these pieces of information are not related to depression. If judges have access to this information, this will influence their judgments of depression. They might take weight information which is diagnostic of depression less when making their assessments of depression. Based on this logic, judges were assigned to one of two conditions: access to only text from the status updates and access to the entire profile. I predict that accuracy will be greater when judges which only have access to status updates.

In addition to examining the accuracy of depression, another aim of the study was to investigate whether changes in depression could be assessed from the Facebook pages. Practically, this would useful to determine whether the early signs of depression could be detected before a person becomes severely depressed. This would also suggest that social networking sites can be used as a monitoring tool for depression and have important clinical applications. Theoretically, this will test the degree to which information on Facebook reflects the early, subtle signs of depression. Specifically, it would show that even though Facebook is a public context, signs of depression leak though the written interactions and status updates on the page. By comparing the levels of accuracy for current and future depression, this will speak to whether Facebook is good for assessing

current depression or if the information on the profiles are sensitive enough to detect future depression.

Another aim of this study is to investigate which individual differences of the targets moderate the level of accuracy. So far, my theoretical framework has focused on contexts which are private and public. It is possible that certain individuals monitor more or less the information which they post on social networking sites. Since the type of information posted on these sites contain important cues of depression (Rodriquez et al., in press), if certain types of individuals only post certain types of information, this should influence the level of accuracy. Drawing on prior research, I focused on three individual difference moderators: Extraversion, dispositional Impression Management, and Public Self-Consciousness.

I expect Extraversion to influence accuracy because Extraverts tend to be more emotionally expressive and, in general, more revealing to others (Anderson, John, Keltner, & Kring, 2001; Gross & John, 1998). In contrast, introverts are more likely to hold in their feelings and hide them from others. Considering that depression is partially expressed through feelings, Extraverted people should express more emotions on their Facebook page. The availability of increased emotions should allow for more accurate assessments of depression. It is possible that Extraverts engage in more behaviors which are socially observable than Introverts and this increases the chance for depressive behavior to leak out. Furthermore, this is consistent with the idea that Extraversion is considered a “good trait”, or a trait which is highly available to other people (Funder, 1999). This suggests that the behavior manifested by Extraverts facilitates accurate

personality judgments. I predict, then, that Extraversion should moderate the level of accuracy such that depression should be easier to judge in targets high on Extraversion.

Dispositional Impression Management concerns the degree to which people are attuned to self-presentation demands and are motivated to self-present (Paulhus & Trapnell, 2008). People high on impression management are guided by the desire to be liked and regarded to as favorable by other people (Baumeister, 1982). Since being depressed is seen as unfavorable, people who are high on Impression Management would conceal signs of depression. Social networking sites (Facebook in particular) post recent activity on the log-in page, so people who are high on Impression Management would not want to post this information which is available to their social network when they log-on to the site. I predict, then, that depression will be harder to judge in targets high on dispositional Impression Management.

Public Self-Consciousness is the degree to which a person is aware of the impressions they make on others (Fenigstein, 2009). People who are high on Public Self-Consciousness focus their attention toward the self as a social object in which the person's main focus is on what others think of him- or herself (Gibbons, 1990). For example, women who score high on Public Self-Consciousness apply more makeup while they prepare for their picture to be taken (Miller & Cox, 1982), Public Self-Consciousness is greater among people with eating disorders (Striegel-Moore, Silberstein, & Rodin, 1993), and people high on Public Self-Consciousness self-handicap before difficult tasks to protect their impressions of competence (Shepard & Arkin, 1989). This is similar to Impression Management such that people who score high on

Public Self-Consciousness aim to present themselves in socially desirable ways. I predict that it would be harder to judge depression in targets high on Public Self-Consciousness.

Method

Participants

124 psychology students who had Facebook pages served as target participants. 98 (79%) were female. 100 participants (81%) identified themselves as white, 10 (8%) as Latino/a, 6 (5%) as Asian, 4 (3%) as African American, and 4 (3%) as other. The targets ranged in age from 18 to 28 ($M = 18.6$, $SD = 1.1$). 11 (9 female) undergraduate research assistants served as naïve raters. 6 raters were in the full profile condition and 5 raters were in the status update only condition.

Phase One: Target Assessment of Depression, Extraversion, Dispositional Impression Management, & Public Self-Consciousness

Target participants were recruited through the introduction to psychology subject pool. Each target participant completed the BDI as part of a larger set of personality questionnaires. In this sample, the mean BDI score at time 1 was 8.87 ($SD = 7.02$, range = 0 to 31). Using the consensual BDI cut-off score of 13 for mild depression, 35 (20.2%) of our sample were at least mildly depressed (Lasa et al., 2000). As part of a larger set of questionnaires, participants also completed, the Big Five Personality Inventory to assess Extraversion (BFI; John & Srivastava, 1999; $M = 5.06$, $SD = 1.15$, range 1.88 to 7.00; $\alpha = .87$), the Balanced Inventory of Desirable Responding, a well-validated trait impression management inventory (BIDR; Paulhus, 1991; $M = 6.09$, $SD = 3.07$, range = 0 to 15; $\alpha = .67$), and the public subscale of the Self-Consciousness Scale to assess the

tendency to think about the qualities of one's self which are used by other people to form impressions (Fenigstein, Scheier, & Buss, 1975; $M = 4.76$, $SD = 1.03$, range = 1.5 to 6.8; $\alpha = .67$). Extraversion, Impression Management, and Public Self-Consciousness were not significantly correlated with each other (r 's < -.14).

Each target participant then downloaded and saved a copy of their Facebook page. Activity on the main part of the page (e.g. the "wall") was saved retrospectively from 3 months prior to completing the questionnaires. Three other sections of the page (in addition to the wall) were saved: the information section which lists likes/dislikes, short self-descriptions, and basic information; the main photo page which lists the number of albums and a few pictures; the boxes section which lists the applications (e.g. bumper stickers, catbook/dogbook) the user has on their page.

Three months after participating in the first part of the study, participants were contacted via email and asked to complete an online questionnaire assessing current levels of depression (using the BDI). 98 (79%) of the participants completed the follow-up questionnaire. There were no differences with respect to demographics, depression, Extraversion, Impression Management, and Public Self-Consciousness between participants who did and did not complete the follow-up questionnaire. At time 2, the mean BDI score was 7.45 ($SD = 8.84$, range 0 to 46). 17 (15.3%) of the sample was mildly depressed or above.

Phase Two: Ratings of Target Depression

Judges were randomly assigned to two groups. In the full profile condition, judges had access to the entire Facebook page (similar to Study 2). In the status update

condition, judges had access to only the transcripts of the status updates from the Facebook page. In both groups, judges were asked to form a first impression of each target participant. Depression was assessed using the same one-item measure as in Studies 1 and 2 as well as a measure of predicted depression (i.e. “how depressed do you believe this target will be 3 months from now?” on a 1 to 7 scale) and changes in depression (“do you believe that the target will be more or less depressed 3 months from now? on a -3[much less] to +3 [much more] scale).

Phase Three: Cue Validity and Cue Utilization Analyses

Similar to Studies 1 and 2, the linguistic cues in the status updates related to depression were correlated with targets’ level of depression and judges’ lay assessments of depression. Additionally, two independent research assistants also coded the status updates for 8 indicators of depressive symptomology based on the criteria determined by the DSM IV. (e.g. sadness, loss of interest, fatigue, feeling sick; overall $\alpha=.92$). The symptoms that fell into the cognitive category ($\alpha = .72$) were feeling sad, loss of interest in activities, feelings of worthlessness, inability to concentrate, and thoughts of death, while symptoms of increase/decrease in appetite, insomnia/hypersomnia, and feeling sick fell into the experiential category ($\alpha = .69$).

Results

Do status updates or full profiles allow for more accurate assessments of depression?

Accuracy. The ratings on the one-item depression measure were averaged across all 6 judges in the full profile condition and 5 judges in the status update only condition to create a composite measure of judged depression for each condition. The level of

agreement among the judges in the full profile condition was .77 and .71 among the judges in the status update condition (using an intra-class correlation [ICC 2,k]; Shrout & Fleiss, 1979). The composite of judges' ratings of depression in each condition was correlated with targets' scores on the BDI to serve as accuracy criterion. Consistent with the prediction that the status updates contain information which is less prone to impression management (compared to other parts of social networking sites), the accuracy correlation in the status update condition was higher ($r = .30, p < .001$) than the accuracy correlation in the full profile condition ($r = .22, p < .01$).

To test whether more information on the profiles produces greater levels of accuracy, ratings of depression in the status update condition and full profile condition were used to predict targets' rating of depression. Since the status updates contained less information, these ratings were used to predict targets' levels of depression first. Regression analyses revealed that depression ratings in the status update condition predicted targets' level of depression ($b = .30, t(122) = 3.42, p = .001$). When ratings of depression in the full profile and status update conditions were entered into a second step to see whether having more information produces greater levels of accuracy, the regression coefficient for the full profile condition became non-significant ($b = .03, t(121) = .28, p = .78$) while depression ratings in the status update condition significantly predicted targets' depression ($b = .27, t(121) = 2.28, p = .02$). This suggests that having more information doesn't produce greater levels of accuracy.

To test whether the status updates allow for greater levels of accuracy over and beyond the full profiles, the ratings in the full profile were entered as the first step of the

regression and the ratings in the status update condition were entered on the next step to see whether status updates produce a significant increase in accuracy. The results reveal that the ratings of depression increased the level of accuracy in predicting targets' level of depression ($R = .22$ to $R = .30$; $F(121) = 5.91$, $p = .02$).

Signal detection analysis. Signal detection analyses were conducted for both the full profile and status update conditions (Tables 5 and 6). The results were similar across both conditions except for the higher sensitivity in the full profile condition (17.1%) compared to the status update condition (5.7%). Consistent with the higher degree of accuracy in this study, these analyses revealed a higher positive predictive value (46.1% and 50%) compared to Study 1 (0%).

Table 5
Signal detection analysis for Study 3 (full profile condition).

	Targets who were judged as depressed	Targets who were judged as not depressed	
Targets who were at least mildly depressed	6 (TP)	29 (FN)	Sensitivity = 17.1%
Targets who were not depressed	8 (FP)	81 (TN)	Specificity = 91%
	Positive predictive value = 46.1%	Negative predictive value = 73.6%	

Note. TP = true positive, FP = false positive, TN = true negative, FN = false negative; BDI cut-off for mild depression is 13; cut-off for judges' ratings in response to the item "I see the target as someone who is depressed" was 4 (neither agree nor disagree) on a 1 (strongly disagree) to 7 (strongly agree) scale.

Table 6
Signal detection analysis for Study 3 (status update condition).

	Targets who were judged as depressed	Targets who were judged as not depressed	
Targets who were at least mildly depressed	2 (TP)	33 (FN)	Sensitivity = 5.7%
Targets who were not depressed	2 (FP)	87 (TN)	Specificity = 97.8%
	Positive predictive value = 50%	Negative predictive value = 72.5%	

Note. TP = true positive, FP = false positive, TN = true negative, FN = false negative; BDI cut-off for mild depression is 13; cut-off for judges' ratings in response to the item "I see the target as someone who is depressed" was 4 (neither agree nor disagree) on a 1 (strongly disagree) to 7 (strongly agree) scale.

What aspects of the Facebook pages are related to subclinical depression and which cues do judges use in making their assessments?

The next set of analyses examined whether depression was related to the language use in the status updates. Table 7 displays the language use cues from the status updates. Consistent with the MySpace profiles (yet, inconsistent with Study 2), using less positive emotions words ($r = -.18, p = .05$) and more death-related words ($r = .31, p = .001$) was related to greater levels of depression. In addition, using more religious words (e.g. God, heaven; $r = .21, p = .02$), metaphysical words (e.g. faith, moral; $r = .31, p = .001$), swear words (e.g. damn, $r = .17, p = .05$), and negative emotion words (e.g. worthless, sad; $r = .18, p = .05$) to increased levels of depression.

Across both the full profile and status update conditions, the cue utilization correlations were similar. There was more cue utilization correlations in the status update

Table 7

Lens model analysis of judges' lay assessments of depression for Facebook status updates (Study 3).

LIWC-derived cues	Example word	Cue validity	Cue utilization	
			Full profile	Status update
<i>Emotional processes</i>				
Positive emotion words	happy	-.18*	-.19*	-.28**
Negative emotion words	worthless	.18*	.34**	.36**
Sadness words	cry	.13	.07	.25**
Swear words	damn	.17*	.13	.18*
<i>Cognitive processes</i>				
Cognitive mechanism words	cause	.08	.21*	.38**
Causation words	because	.07	.11	.17
Insight words	think	.09	.10	.25*
Inhibition words	constrain	.02	.07	.15
<i>Temporal processes</i>				
Past tense verbs	were	-.16	.06	.11
Present tense verbs	be	.14	.09	.22*
Future tense verbs	will	-.07	.11	.00
<i>Social processes</i>				
Social words	friend	.01	-.03	-.07
1 st person singular pronouns	I	.06	.26**	.17*
1 st person plural pronouns	we	.07	-.06	-.09
<i>Personal concerns</i>				
Metaphysical words	coffin	.31**	.01	.07
Religion words	God	.21*	-.04	.01
Death words	dead	.31**	.15	.16
Sleep words	asleep	.00	.21*	.28**
<i>Depressive symptoms</i>				
Total number of symptoms		.00	.36**	.38**
Experiential symptoms		-.03	.39**	.37**
Behavioral symptoms		-.04	.29**	.32**

Note. $N = 124$ for targets; $N = 6$ for judges in full profile condition; $N = 5$ for judges in status update condition. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC = Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

condition most likely because that group of judges were restricted to the language use

contained in the status updates. Judges correctly utilized positive emotion words, negative emotion words, and swear words in making ratings of depression.

Follow-up analyses were conducted to determine which language cues predict depression to the greatest extent and to determine whether judges' ratings predict depression over and beyond the language cues. The results revealed that death related words and religious words significantly predicted depression when entered with all the other language cues in the first step of a regression equation. In both the full profile and status update condition, when judges' ratings of depression were entered on the second step of the regression equation with the language cues, judges' ratings still significantly predicted depression ($b = .18$, $t(117) = 1.98$, $p = .05$ and $b = .24$, $t(117) = 2.67$, $p = .01$, for the full profile and status update conditions, respectively). Additionally, the R square change significantly increased for both conditions ($R = .41$ to $R = .44$; $F(117) = 3.89$, $p = .05$ for the full profile condition and $R = .41$ to $R = .47$; $F(117) = 7.01$, $p = .01$ for the status update condition). This suggests that although the language cues predict depression (especially death and religion words), judges' ratings predict depression over and beyond the language cues. It is also worth noting the importance of the language cues. They explain 41% of the variance, while judges ratings add 3% (in the full profile condition) and 6% (in the status only condition) in additional explained variance.

Table 7 also displays the cue validity and utilization correlations for the depressive symptomology coding. None of the depressive symptoms were valid indicators of depression – although judges used them when making ratings of depression.

Can Facebook pages be used to detect future depression?

Two different approaches were used to calculate the level of accuracy for detecting future depression. Similar to assessing current levels of depression, ratings for each group of judges on the one-item measure of depression (e.g. “how depressed do you believe this target will be 3 months from now?”) were averaged to create a composite measure of judged future depression. The level of agreement among the judges was similar to previous levels of agreement (.75 for the full profile condition and .65 for the status update only condition). The composite ratings were then compared to targets’ BDI scores three months after completing the initial assessment of depression and saving their Facebook profiles. Consistent with the idea that Facebook profiles contain information that can be used to gauge future levels of depression, judges made significantly accurate assessments of future depression in both conditions (r 's = .26, p = .05 in both the full profile and status update only conditions).

The accuracy of future depression was also calculating by computing change scores of depression where targets’ time 2 depression scores were residualized for depression at time 1. The residualized time 2 depression scores were then correlated with judges’ estimates of changes of depression (“do you believe that the target will be more or less depressed 3 months from now?”) as a measure of accuracy. Inconsistent with my predictions, the level of accuracy was low and non-significant for changes of depression (r = .02, p = .82 for the full profile condition and r = .00, p = .98 for the status update condition).³

³ Accuracy was also calculated using judges’ ratings of future depression residualized for judges’ ratings of current depression. The accuracy correlation in the full profile condition was -.12 and the accuracy correlation in the status update condition was -.01.

Which individual differences moderate the level of accuracy?

To examine how individual differences moderated the level of accuracy, targets were divided into high and low groups based on a median split on each personality trait (median Extraversion = 5.12, median Impression Management = 6.0, median Public Self-Consciousness = 4.83). Accuracy correlations for assessments of depression were computed separately for each group (e.g. high, low) for each condition. Further, I computed two different types of accuracy correlations; estimates of current depression and estimates of changes in depression.

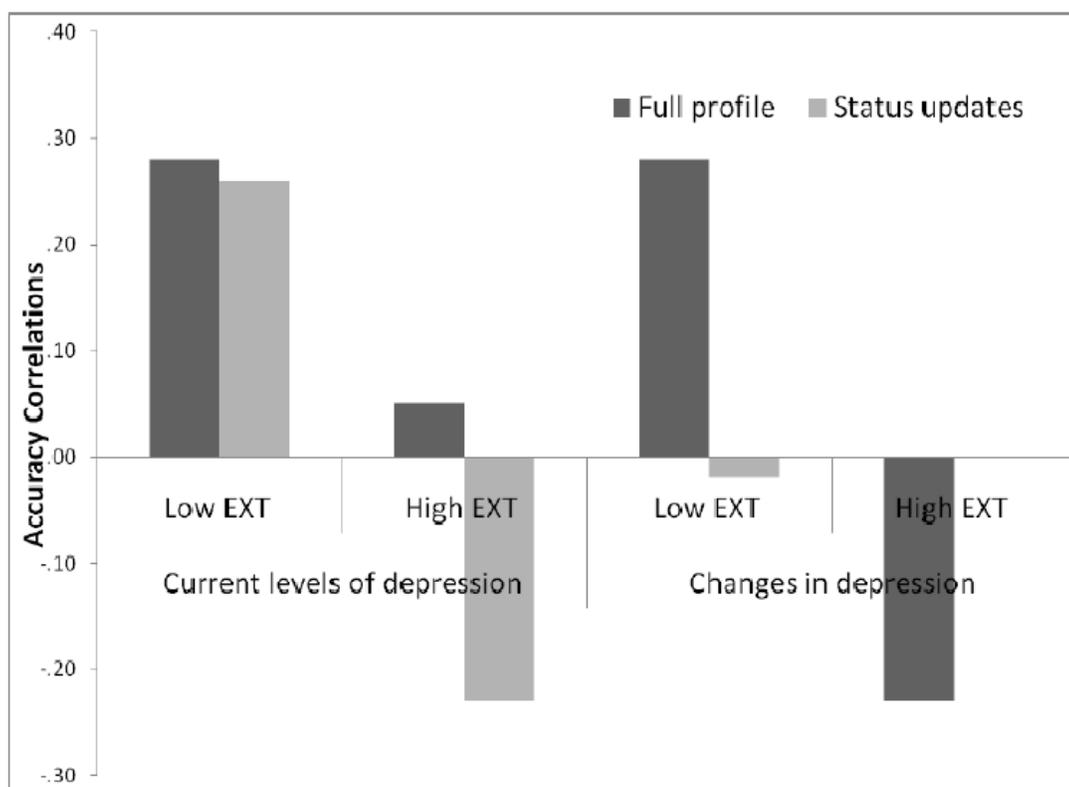
Using median splits might not be the optimal data analytic approach since our individual difference variables are continuous (DeCoster, Iselin, & Gallucci, 2009). However, the outcome measure is a correlation between judges' ratings of depression and targets' depression which does not fit with a moderated regression approach. As established by previous research on individual difference moderators (Letzring, 2008), the analysis was conducted using a median split on the individual difference variables.

Extraversion. Figure 1 displays the accuracy correlations for each condition split by high/low Extraversion. Contrary to the idea that people who are highly Extraverted express more emotions, thus making it easier to gauge depression, the overall accuracy (defined as the composite accuracy correlations for current and changes in depression) was greater for targets who scored low on Extraversion compared to targets who scored high on Extraversion. In the full profile condition, the overall accuracy was .28 ($p = .03$) for targets low in Extraversion and -.09 ($p = .49$) for targets high in Extraversion, while in

the status update condition overall accuracy was .12 ($p = .34$) for targets low in Extraversion and .13 ($p = .30$) for targets high in Extraversion. Hotelling's t-tests (with

Figure 1

Accuracy of current and change in depression by targets' level of extraversion across the full profile and status update conditions



Williams Modification) indicated that the pairs of correlations in the full profile condition were significantly different from each other ($p = .02$), while the correlation in the status update condition were not significantly different from each other ($p = .52$).

Within the full profile condition, the level of accuracy for changes of depression was significantly greater for targets low in Extraversion compared to targets high in

Extraversion ($r = .28$ vs. $r = -.23$). Within the status update condition, none of the levels of accuracy were significantly different from each other.

The full profile and status update conditions yielded similar results except in two cases. First, there was no difference between the accuracy for assessing current levels of depression for both targets high in Extraversion ($r = .26, p = .05$) or low in Extraversion ($r = .25, p = .05$) for the status update condition. Second, judges in the full profile condition were the only group who could only identify changes in depression for targets low in Extraversion ($r = .28, p = .05$). Both of these differences in accuracy could point to information contained on other parts of the profile that aided judges in the full profile condition to accurately assess changes of depression or inhibit this group of judges in assessments of current levels of depression.

Table 8 displays the language and depressive symptomology cue validity and utilization correlations separated by targets' level of Extraversion. The results indicate that depression is related to using less positive emotions only for targets who score high on Extraversion, as well as using more meta-physical and religious words. For targets who scored low on Extraversion, the number of depressive symptoms (especially behavioral symptoms) is negatively related to depression, such that the more depressed a target is, the less they display symptoms in their status updates. The cue utilization was similar across both the full profile and status update conditions. When the differences between targets' high and low on Extraversion were examined, judges' ratings of depression corresponded to the total number of depressive symptoms and behavioral

symptoms for targets high on Extraversion. Since these were not valid cues to depression, this could account for the lower degree of accuracy.

Table 8

Lens model analysis of judges' lay assessments of depression for Facebook status updates by target Extraversion: cue validity and cue utilization.

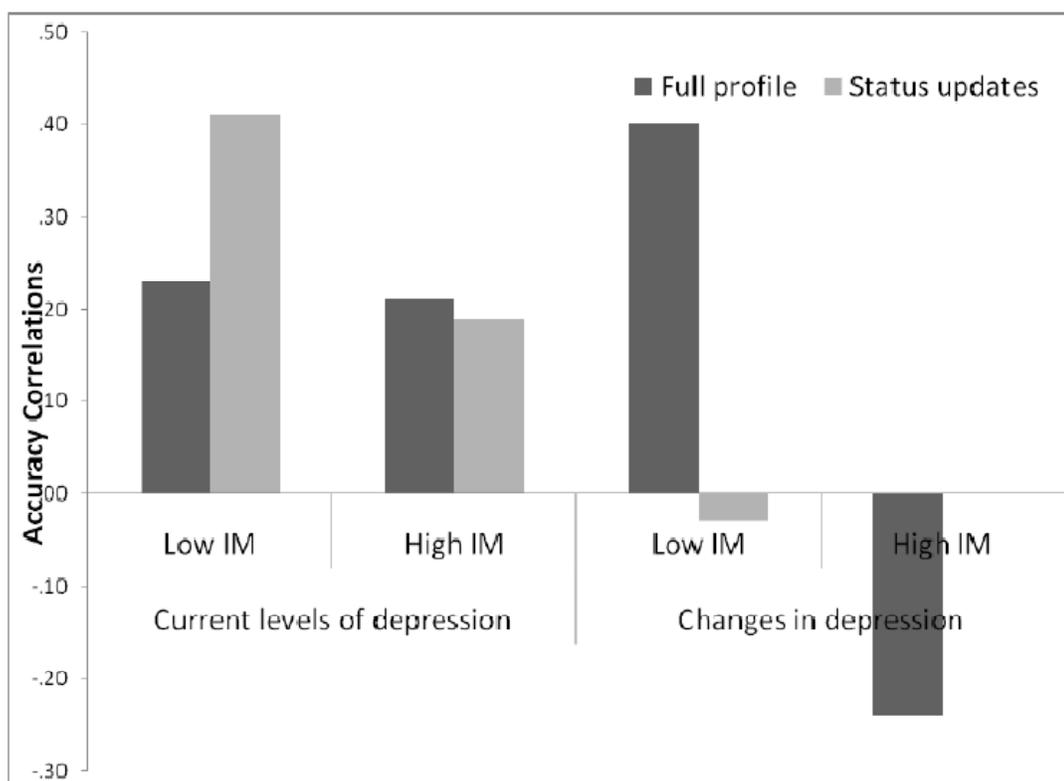
LIWC-derived cues	Cue validity (<i>r</i>)		Cue utilization full profile (<i>r</i>)		Cue utilization status update (<i>r</i>)	
	Low EXT	High EXT	Low EXT	High EXT	Low EXT	High EXT
<i>Emotional processes</i>						
Positive emotion words	.07	-.34**	-.19	-.11	-.22	.26*
Negative emotion words	.11	.20	.33**	.29*	.20	.49**
Sadness words	-.03	.23	-.02	.10	.23	.26*
Swear words	.10	.22	.08	.14	.07	.25*
<i>Cognitive processes</i>						
Cognitive mechanism words	-.04	.12	.32**	.05	.38**	.31*
Causation words	.00	.09	.12	.04	.14	.14
Insight words	-.01	.12	.22	-.07	.29*	.16
Inhibition words	.01	.01	-.04	.18	.08	.21
<i>Temporal processes</i>						
Past tense verbs	-.13	-.22	.18	-.09	.20	-.01
Present tense verbs	.03	.15	-.02	.08	.04	.25*
Future tense verbs	.04	-.14	-.04	.21	-.05	.00
<i>Social processes</i>						
Social words	.05	-.01	-.03	-.02	-.17	.07
1 st person singular pronouns	.18	-.09	.20	.31*	.22	.09
1 st person plural pronouns	.10	.07	.13	-.21	.04	-.18
<i>Personal concerns</i>						
Metaphysical words	.18	.43**	.11	-.08	.10	.04
Religion words	.03	.37**	.02	-.08	.05	.02
Death words	.34**	.24*	.20	.00	.13	.10
Sleep words	-.10	.05	.12	.29*	.19	.37**
<i>Depressive symptoms</i>						
Total number of symptoms	-.26*	.15	.23	.48**	.21	.54**
Experiential symptoms	-.15	.11	.35**	.40**	.27*	.45**
Behavioral symptoms	-.28*	.16	.11	.46**	.14	.53**

Note. $N = 124$ for targets; $N = 6$ for judges in full profile condition; $N = 5$ for judges in status update condition. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC = Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

Impression Management. Figure 2 displays the accuracy correlations for each condition split by high and low Impression Management. Consistent with the idea that targets who score high on dispositional impression management will censor the

Figure 2

Accuracy of current and change in depression by targets' level of impression management across the full profile and status update conditions



information they post on their Facebook page and is harder to gauge depression from, the overall level of accuracy was lower for targets who are high in Impression Management. In the full profile condition, the overall accuracy was .32 ($p = .01$) for targets low in Impression Management and -.02 ($p = .87$) for targets high in Impression Management,

while in the status update condition overall accuracy was .19 ($p = .16$) for targets low in Impression Management and .10 ($p = .41$) for targets high in Impression Management. Hotelling's t-tests (with Williams Modification) indicated that the pairs of correlations in the full profile condition ($p = .01$) was significant from each other and the correlations in the status update condition were not significantly different from each other ($p = .31$).

Within the full profile condition, the level of accuracy for changes of depression was significantly greater for targets low in Impression Management compared to targets high in Impression Management ($r = .40$ vs. $r = -.24$). Within the status update condition, none of the pairs of correlations were different from each other.

Although the two conditions yielded similar results, targets' level of impression management did not influence estimates of current levels of depression in the full profile condition with both of these conditions achieving marginally significant levels of accuracy ($r_{\text{low}} = .23, p = .08; r_{\text{high}} = .21, p = .09$). However, judges estimates of changes depression in the full profile condition for targets low on Impression Management were the only estimates to achieve significant, substantial levels of accuracy ($r = .40, p < .01$). In the case of current ratings of depression, these findings suggest that impression management did not influence the level of accuracy when raters had access to the full profile. Impression management did influence the level of accuracy in changes of depression for the full profile condition.

Table 9 displays the cue validity/utilization correlations for targets who scored high and low on Impression Management. The cue validity look similar across both groups, however using less positive emotions, fewer past tense verbs, and greater

metaphysical/religious words was related to depression for targets high on Impression Management. The increased use of death words was related to depression for targets who scored low on Impression Management. The cue utilization correlations were similar

Table 9

Lens model analysis of judges' lay assessments of depression for Facebook status updates by target Impression Management: cue validity and cue utilization.

LIWC-derived cues	Cue validity (<i>r</i>)		Cue utilization full profile (<i>r</i>)		Cue utilization status update (<i>r</i>)	
	Low IM	High IM	Low IM	High IM	Low IM	High IM
<i>Emotional processes</i>						
Positive emotion words	-.17	-.24*	-.25	-.13	-.40**	-.17
Negative emotion words	.12	.19	.27*	.41**	.32*	.42**
Sadness words	.23	.10	.08	.06	.35**	.16
Swear words	.11	.18	.01	.31**	.10	.30**
<i>Cognitive processes</i>						
Cognitive mechanism words	.13	.06	.26	.17	.47**	.27*
Causation words	.08	.13	.09	.12	.22	.12
Insight words	.08	.15	.10	.11	.37**	.12
Inhibition words	.15	-.02	.21	-.05	.22	.08
<i>Temporal processes</i>						
Past tense verbs	-.05	-.27*	.12	-.01	.23	-.04
Present tense verbs	.18	.09	.17	.01	.24	.19
Future tense verbs	-.21	.14	.12	.09	-.10	.11
<i>Social processes</i>						
Social words	.01	.03	-.13	.06	-.19	.05
1 st person singular pronouns	.10	-.02	.27*	.24*	.24	.10
1 st person plural pronouns	.15	-.01	-.01	-.11	-.01	-.17
<i>Personal concerns</i>						
Metaphysical words	.21	.43**	.02	.00	.17	-.02
Religion words	.06	.39**	-.13	.02	.06	-.03
Death words	.34**	.13	.29*	-.09	.26	.03
Sleep words	-.10	.15	.13	.29*	.22	.34**
<i>Depressive symptoms</i>						
Total number of symptoms	.03	.05	.37**	.41**	.42**	.39**
Experiential symptoms	.11	-.01	.47**	.38**	.41**	.37**
Behavioral symptoms	-.04	.08	.23	.37**	.33**	.35**

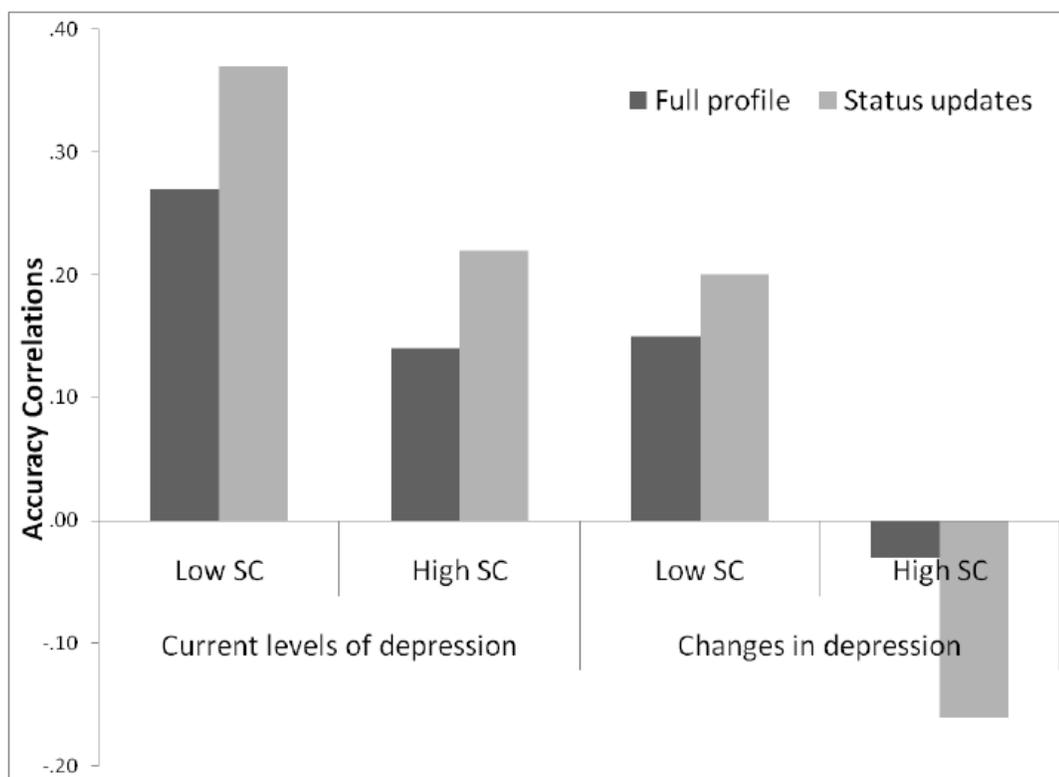
Note. $N = 124$ for targets; $N = 6$ for judges in full profile condition; $N = 5$ for judges in status update condition. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC = Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

across both the full profile and status update conditions. However, judges used negative/positive emotion words and cognitive words when making assessments of depression in the status update condition (which is especially true for targets low on Impression Management). In addition, across all conditions and levels of Impression Management, judges used depressive symptomology in their ratings of depression.

Public Self-Consciousness. Figure 3 displays the accuracy correlations for estimates of depression split by high/low public self-consciousness across both conditions. Consistent with the pattern for impression management, the overall levels of accuracy was greater for targets who scored low on public self-consciousness (that is,

Figure 3

Accuracy of current and change in depression by targets' level of public self-consciousness across the full profile and status update conditions



targets who are less concerned with the impression they make on other people) than for those who scored high on the trait. In the full profile condition, the overall accuracy was .21 ($p = .11$) for targets low in Public Self-Consciousness and .06 ($p = .63$) for targets high in Public Self-Consciousness, while in the status update condition overall accuracy was .29 ($p = .03$) for targets low in Public Self-Consciousness and .03 ($p = .81$) for targets high in Public Self-Consciousness. However, these sets of correlations were not

significantly different from each other. None of the other accuracy correlations were significantly different from each other within condition.

The two conditions again yielded similar results and were consistent with findings using Impression Management as a moderator. However, in this case, none of the ratings for changes of depression achieved significant levels of accuracy.

Table 10 displays the cue validity/cue utilization correlations separated by targets' level of Public Self-Consciousness. In general, there were more valid indicators of depression for targets low on Public Self-Consciousness. For example, using more negative emotions, swear words, insight words, present tense verbs, metaphysical, death, and religious words were related to higher levels of depression. For targets high on Public Self-Consciousness, using less positive emotions, more 1st person singular pronouns, and death-related words were related to depression. The cue utilization looked similar across the two conditions, however judges used more language and depressive symptomology cues when rating targets high on Public Self-Consciousness.

Table 10

Lens model analysis of judges' lay assessments of depression for Facebook status updates by target Public Self-Consciousness: cue validity and cue utilization.

LIWC-derived cues	Cue validity (<i>r</i>)		Cue utilization full profile (<i>r</i>)		Cue utilization status update (<i>r</i>)	
	Low SC	High SC	Low SC	High SC	Low SC	High SC
<i>Emotional processes</i>						
Positive emotion words	-.08	-.25*	-.17	-.19	-.18	-.35**
Negative emotion words	.27*	.11	.05	.52**	.14	.53**
Sadness words	.09	.15	-.13	.21	.12	.38**
Swear words	.31*	.05	-.03	.24	.03	.30*
<i>Cognitive processes</i>						
Cognitive mechanism words	.18	.01	.16	.27*	.35**	.40**
Causation words	.04	.08	.13	.08	.11	.24
Insight words	.27*	-.06	.03	.15	.22	.29*
Inhibition words	.00	.17	-.08	.28*	.10	.25*
<i>Temporal processes</i>						
Past tense verbs	-.15	-.16	.07	.06	.07	.15
Present tense verbs	.35**	.06	-.07	.28*	.15	.33**
Future tense verbs	-.12	-.07	.28*	.02	.21	-.15
<i>Social processes</i>						
Social words	.05	-.05	-.06	-.03	-.06	-.09
1 st person singular pronouns	-.18	.25*	.21	.30**	.05	.29*
1 st person plural pronouns	.14	-.02	-.11	-.06	-.05	-.14
<i>Personal concerns</i>						
Metaphysical words	.53**	.16	.14	-.08	.20	-.03
Religion words	.39**	.09	.12	-.14	.22	-.12
Death words	.38**	.28*	.08	.24	.04	.33**
Sleep words	-.02	.01	.21	.23	.22	.36**
<i>Depressive symptoms</i>						
Total number of symptoms	-.10	-.01	.26*	.42**	.24	.50**
Experiential symptoms	.05	-.08	.32**	.43**	.33**	.41**
Behavioral symptoms	-.16	.03	.20	.36**	.17	.48**

Note. $N = 124$ for targets; $N = 6$ for judges in full profile condition; $N = 5$ for judges in status update condition. Targets' depressive symptoms were assessed with the Beck Depression Inventory (BDI). Judges rated targets' depression using a single item measure. LIWC = Linguistic Inquiry and Word Count; the LIWC-derived cues are computed as proportions of the total number of words; indented LIWC variables are subcategories; * $p \leq .05$; ** $p \leq .01$.

Discussion

Study 3 examined both environmental and individual difference moderators to determine which conditions depression can be accurately gauged from Facebook profiles. The results revealed (contrary to Study 2) that depression can be judged from the full, complete information available on a Facebook profile. Furthermore, when raters were given only the text from the status updates on a profile, they achieved descriptively (but not statistically) greater levels of accuracy. In addition, the results revealed that having access to the full profile doesn't result in a greater level of accuracy. These results are consistent with findings that having less information available can result in equal or greater levels of accuracy (Ambady & Rosenthal, 1992; Borkeanu & Leibold, 1992; Holleran, Mehl, & Levitt, 2009; Paulhus & Bruce, 1992). More importantly, the results suggest that the spontaneous thoughts and feelings in status updates provide relevant information to gauge depression while other information on the profile may detract judges from making accurate assessments. Theoretically, these results point to the idea that depression is easier to judge directly from a person's thoughts and feelings rather than by evidence of their social interactions (e.g. the number of friends on Facebook, mini-conversations with friends on their wall).

The results of this study also found that targets' level of Extraversion and Impression Management might serve as important individual difference moderators such that the lower levels of Extraversion and Impression Management result in greater levels of accuracy in assessing depression. Although I predicted that Extraverts are more likely to express emotions which could be indicative of signs of depression, Extraverts also

display more social-related information which could mask signs of depression. A majority of participants were in their first semester of college and invited to a great deal of “beginning of college” social events (e.g. parties in the dorms, rushing fraternities/sororities). Subsequently, many of the status updates, wall posts, and pictures centered around these events. Introverts, on the other hand, might have self-selected out of some of these events and their Facebook profiles may therefore relatively reflect more thought and feeling related content rather than social event related content thus making it easier to judge depression. This idea is consistent with environmental selection in which certain individuals choose to enter or avoid existing environments (Buss, 1987; Ickes, Snyder & Garcia, 1997) and these results suggest that online social networking profiles may be a new environment in which situation selection exists.

Dispositional impression management reflects the degree to which a person censors information about themselves from other people. The results of the current study found that depression is harder to judge for people who score high on dispositional impression management. Theoretically, this aligns well with the idea that a highly evaluative trait like depression (which people are prone to hide from others) is even harder to detect in people who already censor information themselves⁴. Similar, yet somewhat weaker, results were found for the public self-consciousness. Public self-consciousness reflects the extent to which a person is aware of how they are perceived by

⁴ Since Impression Management influences the level of accuracy, one implication of these findings is how friends can identify people who score high or low on Impression Management. People high on Impression Management have less Facebook friends ($r = -.22$, $p = .01$), use less anger words ($r = -.31$, $p = .001$), more sadness words ($r = .21$, $p = .02$), less death-related words ($r = -.20$, $p = .03$), and less swearing ($r = -.26$, $p = .001$) in status updates.

others. Both impression management and public self-consciousness encompass an increased level of self-awareness, but impression management might reflect more of a deliberate action to censor information. For example, the questions on the BIDR (to assess Impression Management) focuses on behavioral aspects (e.g. “I never drop litter on the streets” and “I don’t gossip about other people’s business”), while the Public Self-Consciousness questionnaire focuses on gestalt tendencies (e.g. “I’m concerned about the way I present myself”; “I’m usually aware of my appearance”). This might explain why there was a stronger effect for impression management.

Study 3 also extended prior findings by determining whether future levels of depression can be detected from Facebook profiles. The results reveal that estimating how depressed a person will be in the future does correlate with how depressed they actually are in the future. However, the results did not hold when controlling for prior depression suggesting that it is harder to judge changes in depression. The results did reveal that when judges had access to the full profile and the target was low in Extraversion or low in Impression Management changes in depression could be accurately gauged. This was surprising since this is not true when judges had access to only the status updates. These findings suggest that information on the profile beyond what is contained in status updates allow judges to estimate depression trajectories more accurately. Perhaps judges took into account interactions between the targets and their friends on their wall and noticed early signs of depression such as decreases in the quality of social interactions (e.g. shorter exchanges compared to longer, in-depth conversations)

which would be consistent with the finding that the quality of interactions is related to depression (Nezlek et al., 2000).

Overall, the findings from Study 3 suggest that depression can be judged from Facebook profiles and point to conditions in which it is easier or harder to gauge depression. Interestingly, the accuracy correlation from Study 2 to Study 3 is almost twice as high. This could be due to the time of year the study was conducted. It's possible that the high school to college transition is a better time to detect signs of depression. Since this is a life changing event, it's possible that this was a more emotional time in student's life and could capture the range of responses to this situation (e.g. from becoming depressed and sad to relishing the new and exciting first semester in college).

Chapter 5

GENERAL DISCUSSION

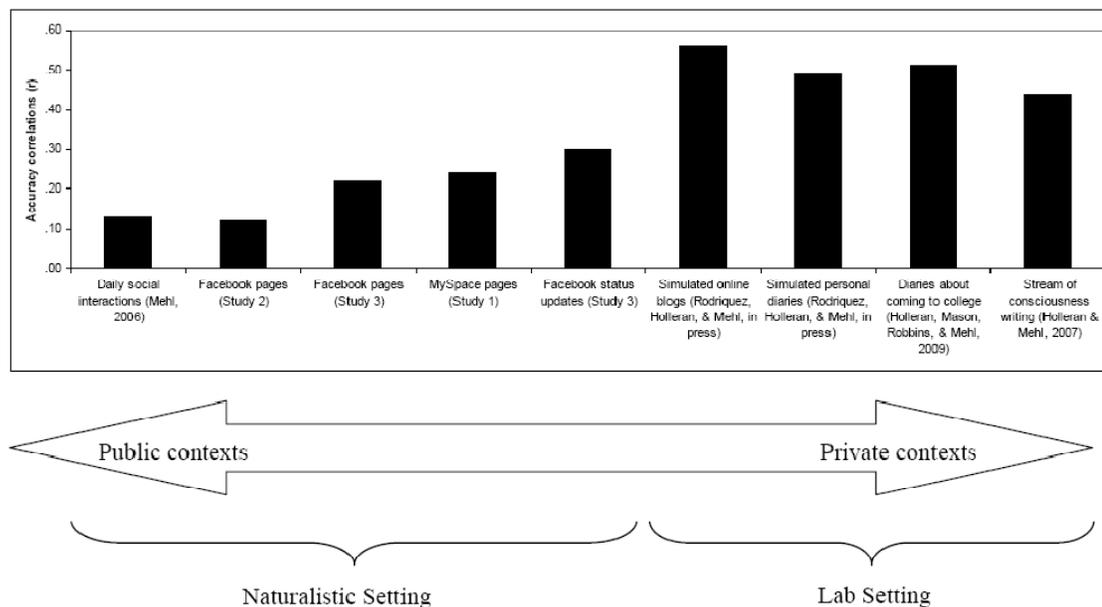
The goal of the current set of studies was to examine if depression can be accurately gauged from social networking sites. Studies 1 and 2 yielded mixed results suggesting that depression can be judged from MySpace profiles, yet it was harder to judge from Facebook profiles. Study 3 identified several moderators of accuracy that suggested depression could be assessed from Facebook profiles. The results from this study suggest that depression can be judged when only viewing status updates. Interestingly, judges were also able to judge depression from the full profiles which exceeded the level of accuracy from Facebook profiles in Study 2 and resembled similar levels of accuracy as the MySpace pages in Study 1. Several individual difference moderators also emerged to suggest it is easier to judge depression from people who are Introverted or dispositionally less likely to censor information about themselves (e.g. low on Impression Management).

Theoretical Implications for Detecting Depression

Depression is a highly evaluative trait, that is, a trait which people are likely to hide from others. In addition, I have argued that impression management processes occur more in public contexts compared to private contexts. Following from these ideas, depression should be easier to detect in private contexts compared to public contexts. Figure 4 displays the accuracy correlations for all of the available research (the current studies plus prior published research) on detecting depression. It is interesting that the

Figure 4

Summary of effect sizes for the accuracy of assessments of depression organized by degree of private and public context



lowest correlations seem to occur in more public contexts (e.g. daily life, social networking websites) and the higher correlations occur in more private contexts (e.g. personal writing samples). Of course, there are other dimensions that vary as well across these studies. For example, the studies differ in terms of being collected in naturalistic contexts or lab contexts. The accuracy correlations seem to be greater in lab contexts compared to naturalistic contexts.

Prior research suggests that depressive symptoms are hard to detect from social interactions (i.e. Mehl, 2006; Nezlek et al., 2001), however these data demonstrate that a special form of social interactions (e.g. social networking sites) make depression more easily detectable. Social networking sites contain both elements of a public environment (since posted information is available to a network of friends) and elements of a private environment (with the interactions occurring over computer mediated communication)

which makes this a unique environment for studying social interactions. It is possible that this type of computer mediated communication creates a sense of security and privacy which allows information relevant to detecting depression to emerge. Because people are not communicating face-to-face in these mediums, they worry less about immediate feedback from their social network and have the chance to formulate and edit the content they post. Theoretically, this creates an environment that is subjectively private yet is objectively public in its purpose or function.

Another important aspect of social networking sites is the degree to which thoughts and feelings are expressed. According to the DSM depressive symptoms manifest themselves primarily in a person's thoughts and feeling (e.g. thoughts of worthlessness, suicide, inability to concentrate). The results of these studies suggest that the blogs on MySpace profiles or the "mini-blog" Facebook status updates contains thoughts and feelings which are relevant to detecting depression. Interestingly, the amount of information (either pages of written blogs or 120 characters or less) did not influence how well depression was detected (especially comparing Study 1 and 3). I argue that it is the longitudinal component of these profiles which makes depression easier to detect. In essence, it allows for a baseline positive/negative mood to be established and makes it easier to interpret long and short term changes. Study 3 provides initial support for this idea by finding that future levels of depression can be accurately judged. This idea could be further tested by establishing the threshold for changes in mood to determine when a person is becoming depressed. It is possible that sustained negative mood over a short period of time (e.g. one week) is indicative of depression on

social networking sites or if the negative mood extends across a longer period of time (e.g. two months).

These studies also provide important evidence that language use is related to depression. Across both Studies 1 and 3, using less positive emotion words and more death related words were related to increased levels of depression. This is consistent with prior research and theories on the role of language use and depression (Rodriguez et al., 2010). Study 3 also provided additional evidence that other language cues (swear words, negative emotions, metaphysical/ religious words) were related to depression. Theoretically, these findings align with prior research linking language and depression.

Follow-up analyses in Study 3 found that valid indicators for the linguistic cues explained 41% of the variance in targets' depression. Importantly, when judges' ratings of depression were added into the regression equation, they added a lesser (although statistically significant) amount of variance. These analyses point to the importance of language use in detecting depression. For social networking companies, these findings could point to the potential of using automated text analysis as a way to "flag" profiles for depression. However, the analyses also suggest that ratings of depression contribute to predicting depression and human judges (compared to an automated computer program) are useful in predicted depression. For social networking companies, it might be more cost-effective to use automated text analysis. However, the significant contribution of human judges should not be underestimated since viewing friends activity on social networking sites is one of the main functions of social networking sites. It is likely that

people naturally identify friends who are depressed based on their profiles. Ideally, both text analyses and human judges should be used in conjunction to detect depression.

Studies 2 and 3, surprisingly, show a lack of cue-validity for depressive symptoms coded from DSM criteria. That is, self-reported depression does not correspond to the number of depressive symptoms present in Facebook status updates. These findings are inconsistent with anecdotal evidence and information reported in the media. One explanation for the findings is the relatively low base-rate of some of the depressive symptoms. Both death-related thoughts and lack of appetite did not occur in the status updates. Other symptoms, such as feeling tired and sick, occurred more often. This could be a by-product of the typical feelings of first semester college students and not necessarily indicative of depression in this population. However, even though depressive symptomology in status updates was unrelated to actual depression, raters used this information in making judgments of depression. It might be surprising that raters still achieved a degree of accuracy in detecting depression. One explanation might be overlap between the language categories and the depressive symptomology coding. For example, the linguistic category of negative emotion words contain words like “sad”, “cry”, and “alone” which is similar to DSM symptoms of depression. However, this is a broader category compared to the DSM symptom coding and perhaps captures a broader range of negative emotions which are indicators of depression.

In addition, Study 3 allowed differences in cue validity across targets' levels of Extraversion, Impression Management, and Public Self-Consciousness to be examined. In general, there are more valid cues to depression contained in language use for people

high in Extraversion, high in Impression Management, and low on Public Self-Consciousness. Theoretically, this aligns with the idea that Extraverts express more emotions, so it is possible that when they are feeling depressed, they express more emotions to other people. The findings for Impression Management are opposite of what would be theoretically expected because people high on Impression Management should censor thoughts and feelings. The findings for Public Self-Consciousness fit with this idea that there are more valid cues for depression for people who do not censor their behavior. Overall, these results suggest that the ways that depression is expressed is influenced by individual differences.

Practical Implications for Detecting Depression

The results of these studies raise questions about the practicality of using social networking sites as a means to detect depression. The signal detection analyses point to the practicality of how good strangers are at identifying someone who is depressed from looking at the person's social networking profile. First and foremost, these analyses show that raters often misclassify people who are depressed as being not depressed (i.e. have a low number of true positives and a high number of false negatives). In the current studies, the signal detection analyses were calibrated to a cut-off point for ratings of depression as a 4 (neither agree nor disagree) on a 7 point scale. Practically, this may not be a good cut-off point because people are generally conservative in rating a person as depressed. In support of this idea, in the current studies, the mean ratings of depression were below the cut-off point. The signal detection analyses revealed that raters were very good in detecting people who were non-depressed (i.e. a high number of true negatives and low

number of false positives). Overall, these analyses suggest that it is more likely that someone will be classified as non-depressed rather than depressed. These analyses also point to the importance of knowing which pieces of information on social networking profiles are valid cues to depression (e.g. language cues) in order to “zoom” in attention to these diagnostic cues to detect depression.

For friends and family, using social networking sites may be a practical and easy way to easily “check-up” on friends without directly asking the person how they are doing. Since depression is something which people do not readily admit to (NIMH, 2001) or discuss freely in everyday life (Mehl, 2006), social network sites may contain other indirect clues to detecting depression. In fact, social networking sites are constructed in a way that allows users to view the activity on their friends’ pages. For example, in Facebook, users immediately see a page entitled “news feed” which alerts them to friends’ recent activity. Consistent with Study 3’s findings that status updates allow for the detection of depression, one suggestion is to have Facebook users set their Facebook homepage to see only status updates compared to seeing all the activity that is occurring on a friend’s Facebook page. This setting allows users to filter out information which is less relevant to detecting depression by focusing specifically on status updates.

Study 3 also revealed that several individual differences influence that degree of accuracy in assessing depression. It is harder to judge depression in people who are Extraverted or high on Impression Management. It does not mean, however, that it is impossible to detect depression in friends who are Extraverted or score high on Impression Management. Research indicates that other people can detect Extraversion

very easily from brief pieces of information (Holleran & Mehl, 2010), so a person is likely to correctly identify which of their friends are highly Extraverted. When looking for signs of depression, people may have to pay attention to different pieces information when looking at their Extraverted friends, or “read through the lines”, when looking at their profiles. I argue that Extraverted people post more information about social events and have more social interactions on social networking sites, and based on prior research, the number of social interactions is unrelated to depression (Mehl, 2006; Nezelek et al., 2001). Instead, I argue that depression is related to information related to expressing thoughts and feelings (e.g. status updates, blogs) and users should focus on this information – especially for their extraverted friends.

However, it is harder (if not impossible) to identify friends who score high on Impression Management. People who are dispositionally high on this trait naturally hide information from other people. This is more prevalent though in highly public settings where information is displayed for the world to see (Paulhus & Trapnell, 2008). Since the majority of information on social networking sites is available for other people to see, one possibility to gauge depression is to send a message to a friend using the internal messaging system on these sites. This approach capitalizes on creating a truly private environment in which people high on Impression Management may feel less compelled to self-present. These types of messages are confidential between people and it may be more likely a person high in Impression Management might confide in a friend in this one-on-one conversation.

For clinicians, social networking sites may also be helpful addition to diagnosing and treating depression. Social networking sites could be used in conjunction with traditional clinical interviews or recommended to friends and family of depressed patients to use to spot signs of a depressive episode. Friends and family could provide not only their own insight in helping someone cope with depression, but also serve as informants to clinicians as to how depression is manifested on social networking sites.

Limitations of the Current Research

Although this line of research has many practical implications, several limitations also exist. First, this research focuses on subclinical depression and most of the participants fall within the normal range of experiencing zero depressive symptoms to a moderate amount of depressive symptoms. Very few of the participants would be classified as severely depressed using clinical cut-off points. This can limit the extent to which these findings can be generalized to detecting depression from severely depressed individuals. It is possible that the behavior of severely depressed individuals would be abnormal and easy to detect (e.g. contemplating suicide on their profiles) or it is possible that severely depressed individuals do not have or are unable to maintain social networking profiles. However, these studies fairly represent the college population which is an important at-risk group for depression.

The second limitation is the criterion for determining accuracy. Although the BDI is one of the most widely used scales to measure subclinical depression (Finan, Tennen, & Zautra, 2009), having other sources of information regarding depression could have strengthened the findings. One solution would be to collect informant reports of

depression and use clinical interviews (e.g. SCID; Spitzer, Williams, Gibbon, & First, 1992) to supplement self-reported BDI. The use of a single accuracy criterion might be one reason that it was harder to detect changes in depression. It is possible that participants in the study sought to answer in similar ways the second time they completed the questionnaire. Although there were changes in BDI scores from time 1 to time 2, it is possible that measures of depression (e.g. clinical interviews) would pick up on more subtle changes in depression. This would allow the accuracy criterion to have greater sensitivity and perhaps align better with the raters' estimates of depression. Even though it was hard to detect changes in depression in Study 3 for the entire sample, the results identified one condition where this was possible – viewing the entire Facebook profile for targets low in Extraversion or low in Impression Management. This suggests that even though it was hard to detect changes in depression, the accuracy criteria worked well in this specific case.

Another limitation of the research is the inconsistency in results from Study 2 and 3. Since the full profile condition of Study 3 was a replication of Study 2, it was surprising that the results were not similar between the two studies. One difference between the two studies is the time of school year they were conducted. Study 2 was conducted in the spring semester and Study 3 was conducted in the fall semester. This difference is important because raters in Study 2 saw information on the Facebook wall from the prior semester and raters in Study 3 saw information from the summer. More importantly, Study 3 caught that transition between high school and college which has been identified as a critical period of adjustment for young adults (Baker & Siryk, 1984).

It is possible that raters had the chance to see how each participant reacted to starting college and (in some cases) moving far away from home. This information could be more diagnostic in detecting depression – which could be one reason why the accuracy correlation was greater in Study 3.

Future Directions

This line of research provides a good starting point for future research which examines where depression can be detected and, more broadly, integrating the zero-acquaintance literature with clinical outcomes. These set of studies have provided initial evidence that depression can be accurately judged from social networking sites, however there are other forms of social media which could be useful in detecting depression. Following up from an in-lab study (Rodriguez et al., in press), examining traditional or multi-media blogs (e.g. blogs containing pictures and videos as well as written language) might be worthwhile in determining how easy it is to detect depression. To further test the influence of impression management concerns, it would be interesting to see how the blogs where anyone could view the postings differ from the blogs which are private or can be selectively viewed by a group of friends. To further test how the spontaneity of statements (i.e. mini-blogs vs. traditional blogs) affects how depression is manifested, an experiment could be conducted where participants are assigned to write in a stream-of-consciousness fashion and then asked to thoroughly edit their writing. If being spontaneous allows more depressive symptoms to “leak” out, there would be a greater amount of depressive symptomology in the spontaneous writing or perhaps depressive

symptoms leak out through different linguistic devices in spontaneous vs. non-spontaneous writing.

Integrating more clinical-related outcomes into zero-acquaintance research is another area for future research. One recent application of this approach found that psychological adjustment can be judged from stream-of-consciousness speaking (Mason, Sbarra, & Mehl, 2010). Other research finds that personality disorders can be accurately judged after brief conversations (Friedman, Oltmanns, Gleason, & Turkheimer, 2006; Oltmanns, Friedman, Fiedler, & Turkheimer, 2004). These studies are excellent examples of incorporating clinically-relevant outcomes into the zero-acquaintance literature. One interesting direction could be to examine the accuracy assessments of psychological well-being among recent military veterans whom have a higher risk for suicide and substance abuse. Both posts on social networking sites or blogging about life after serving in the military could contain important clues to assessing mental health such as PTSD.

Conclusion

Depression is a mental disorder that occurs in many young adults, and if left untreated, can have severe to deadly consequences. The current research used social networking sites as a novel approach for the early detection of depression and provided evidence that depression can be detected. Social networking sites are extremely popular among young adults and can provide a both cost- and clinically effective assessment tool for depression.

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