The Impact of Facebook on Social Comparison and Happiness: Evidence from a Natural Experiment

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Abstract

The ubiquity of Facebook in modern life compels us to study its effects on well-being. We study a unique sample of users and non-users in a security-related organization, where Facebook usage was manipulated by an organizational policy change, initially banning Facebook altogether and later differentially restricting its usage. Thus, the assignment of the employees to the group of non-users was circumstantial rather than due to a-priori personal characteristics, which makes it possible to identify Facebook's impact on social comparison and happiness. We find that Facebook usage increases users' engagement in social comparison and consequently decreases their happiness. Social comparison mediates the effect of Facebook on happiness, but only for the younger half of our sample and only for those who believe that others have many more positive experiences than they do. Surprisingly, we find that Facebook does not cause users to overestimate the frequency of their friends' positive experiences. Thus, the organization's banning of Facebook use had an overall positive effect on the employees' psychological well-being.

Keywords:

Economics of information systems, Happiness, Facebook, Information and communication technologies, Natural experiment, Social comparison

1. Introduction

Facebook is currently the largest online social network, with over one billion users worldwide. During the past decade, it has become an integral part of its users' everyday lives. Drawing on the literature regarding the effect of information and communication technologies (ICT) on social welfare and subjective well-being (Ganju et al., 2016; Greenstein and McDevitt, 2011) and given the prominence of Facebook, we study whether using Facebook affect happiness. While many studies have looked into the personality traits driving differential Facebook usage (see Nadkarni and Hofmann (2011) for a review), the effect of Facebook on the well-being of its users is little understood (Appel et al., 2016). This issue carries managerial implications considering the increasing importance of the firm in moderating its employees' social interactions (Godes et al., 2005).

Alongside the many benefits of Facebook usage, such as maintaining social connections (and possibly even reducing mortality rates (Hobbs et al., 2016)), Facebook may also have the potentially *negative effect* of encouraging social comparison. Because Facebook users tend to post mostly positive experiences and underreport negative ones (Zhao et al., 2008; Mehdizadeh, 2010), we hypothesize that Facebook-driven comparisons with others may be undermining users' happiness. This is in line with existing literature suggesting that upward social comparison (off-platform) decreases happiness (Argyle, 2013; Wood et al., 1985).

Identifying a causal link from Facebook usage to happiness is a challenge in view of the inherent selection bias. It is difficult to devise a proper control group of non-users because the unique individuals who choose not to use Facebook are likely to have personalities that differ from those of the Facebook users (Nadkarni and Hofmann, 2011; Ljepava et al., 2013). A similar selection problem exists in studies that compare the subjective well-being of users with different types or intensities of usage (Chou and Edge, 2012; Tandoc et al., 2015). It is possible that happy people tend to use Facebook differently, and hence one cannot identify the impact of Facebook on

happiness by performing the above comparison. Even longitudinal within-subject studies that compare subjective well-being across time and across types of usage (e.g. Kross et al., 2013; Verduyn et al., 2015) are subject to the possibility that in periods when the participants are happier they also choose to use Facebook more or less intensively. Some studies use path analysis (Baron and Kenny, 1986) to explore the mediating effect of envy, rumination and social comparison on depression (Tandoc et al., 2015; Feinstein et al., 2013) or on life satisfaction (Krasnova et al., 2013; Locatelli et al., 2012). However, this approach does not eliminate the possibility of underlying endogeneity (for a discussion of this issue, see Appel et al., 2016).

This study investigates the impact of Facebook on the perception of others' lives, on social comparison and on happiness, using a unique sample of users and non-users for whom not using Facebook is a circumstantial outcome rather than a result of a personal choice. All the participants are employees of a security-related organization in which the use of Facebook was at first entirely forbidden (during the period 2008-2012), and then differentially restricted. The restrictions, however, became contingent on the projects in which the employee is involved (rather than their function). For example, an administrator and a scientist could have identical restrictions placed on them. Thus, this policy change serves as a pseudo-natural experiment. Indeed, post-study interviews suggest that self-selection into the group of non-users based on individual differences is very small in magnitude (see Section 3.1).

The almost exogenous assignment to each of the two groups - users and non-users - makes it possible to more cleanly measure the *impact* of Facebook on the above-mentioned constructs, without having to be concerned that initial differences in these constructs led to the choice of whether or not to be a Facebook user. Furthermore, the unique research setting provides an additional benefit in that it allows us to account for the *cumulative* effect of Facebook usage 'in the wild', in contrast to lab experiments and short-lived field studies (Kross et al., 2013; Verduyn et al., 2015; Vogel et al., 2015; Lin and Sonja, 2015).

2. Related Literature

2.1 ICTs and online social networks

Information and communication technologies transcend boundaries from the workplace into the home and society in large (Brown, 2008; Walther 1996). Enabled by technologies such as the Internet, the Web and online social networks, computing now mediates the communication and social interactions of many (Preece and Shneiderman, 2009; Kim and Lee, 2011; Walther, 2011). As information and communication technologies become pervasive in everyday life, they influence not only the way in which one communicates, but perhaps also one's psychological well-being (Caplan, 2003) and even the well-being of nations (Ganju et al., 2016).

Online social networks, such as Facebook, became popular ICTs during the first decade of the 21st century. They enable users to maintain social relationships with family and friends by making it easy to share and read updates about one another. Online social networks are essentially a virtualization of the offline social processes (Overby et al., 2010). Over the years, the use of social networks has broadened, and users report using online social networks also for relaxation, entertainment, and socializing (Ku et al., 2013 and Park et al., 2009). Online social networks, like their offline counterparts, have been found to fortify one's self esteem (Gentile et al., 2012; Gonzales and Hancock, 2011; Toma and Hancock, 2013), enforce group identity (Fox and Warber, 2015; Zhao et al., 2008) and increase trust and cooperation (Bapna et al., 2016).

2.2 Online social networks and well-being

Additional benefits of online social networks include increased social capital, social support, and relationship maintenance (Ellison et al., 2007; McEwan, 2013; Nabi et al., 2013). Since social capital and subjective wellbeing are strongly associated (e.g. Bjørnskov, 2003; Helliwell, 2001; Leung et al., 2013), it is reasonable to assume that online social networks increase one's social capital and, in turn, have a positive effect on one's well-being. However, there is a growing body

of evidence to the contrary, referred to as the "Internet paradox" (Kraut et al., 1998). In other words, Internet technology appears to reduce psychological well-being, as manifested in increased depression and loneliness.

It is possible that Internet technology, and in particular online social networks, which are tailored to streamline information flow among users, is a two-edged sword. The platform designers' control of which information is to be highlighted and in what manner affects the evolutionary dynamics of the platforms (Tiwana et al., 2010), as was demonstrated on a broad variety of contexts (e.g. Dellarocas, 2005). In the case of Facebook, the design of the friends feed creates an overwhelming emphasis on others' positive experiences (Chou and Edge, 2012), which gives rise to dynamics of envy, rumination and jealousy (Tandoc et al., 2015; Feinstein et al., 2013; Fox and Moreland, 2015).

Recent studies regarding the use of online social networks among adolescents, students and young adults, have found heterogeneous effects (Valkenburg et al., 2006; Radovic et al., 2017). These findings may suggest that social technologies have an amplifying effect, conditional on the user's characteristics or on the user interactions on the platform.

The broad spectrum of positive, negative and mixed effects of online social technologies, and in particular Facebook, on one's well-being calls for further research. This study, in line with Appel et al. (2016), attempts to exploit natural experimental settings in order to understand the effect of Facebook and to identify its mechanism.

3. Methods

In January 2015, 144 randomly selected employees (M_{age}=25.8; 40% females) filled out a pencil-and-paper questionnaire (hence mitigating the risk of happiness-associated volunteer bias, Heffetz and Rabin, 2013). The sample consisted of 95 users and 49 non-users (34%) of Facebook. The assignment to the groups of users and non-users is described below, followed by a description of the questionnaire and the data analysis method.

3.1. Pseudo-exogenous assignment to Facebook users or non-users

From 2008 to 2012, the organization's employees were not allowed to use social networks (neither at work nor at home). Employees with an existing Facebook account, including employees joining the organization during this period, were asked to delete their account. In 2012, the policy was changed and became contingent on the projects in which the employee is involved (rather than their function). For example, an administrator and a scientist could have identical restrictions placed on them and two engineers might have different restrictions. A very small fraction of employees were now allowed to use Facebook freely; others were allowed restricted use, i.e. they were forbidden to use their full name or upload photos (including a profile picture); the rest were still forbidden to use Facebook. Thus, the research, which was carried out in 2014, included both users and non-users.

This policy change serves as a pseudo-natural experiment: In practice, many employees who worked in the organization before 2012 did not open an account after the policy was changed, even if allowed to. On the other hand, new employees, who joined the organization after 2012, tended to keep their existing Facebook account (unless forbidden to). Thus, Facebook non-users in the organization are mainly employees who are not allowed to use Facebook today and employees who were forbidden to do so until 2012.

We conducted post-study interviews with the organization's non-user employees in order to understand the reasons they do not use Facebook and how those reasons relate to the restrictions placed on them. We interviewed 38 employees who do not use Facebook: 23 who did not have an account and 15 with a non-active account.

When asked to explain why they do not use Facebook, 32 out of the 38 subjects cited the restrictions placed on them by the organization. Only six employees stated that they would not open an account for personal reasons, regardless of the organization's policy. Of those six, three

had restrictions placed on their Facebook use. Furthermore, two of those who did not have restrictions placed on them, did have them in the past. In other words, they had worked in the organization when Facebook usage was totally banned. Thus, their choice to not use Facebook might also have been affected by these unique circumstances.

The interviews suggest that our non-user group includes a small number of employees who do not use Facebook out of choice. For these employees, the choice not to use Facebook may be correlated with some personality trait, which in turn may be correlated with their social comparison and happiness. However, self-selection into the group of non-users based on individual differences appears to be small in magnitude.

We maintain that the differential Facebook policy, which determined the assignment to one of the two groups, is not related to the employee's personality. We also find that the everyday experiences, as reflected in the answers to section E, are not significantly different between users and non-users in our sample (see the attached supplementary materials).

The average age of non-users is greater than that of users in our sample since new employees who joined after 2012 and kept their accounts tend to be younger. This is also related to the higher income of non-users. We control for age and income in our analysis.

3.2 The questionnaire

The questionnaire (which appears in the Appendix), included 6 sections, which were presented in the following order:

A. **Demographics**: age, gender, family status, three levels of education and five levels of income.

B. **Friends' experiences:** We were interested in ascertaining how participants perceive others' lives as compared to their own, but didn't want to reveal our intention directly in the questionnaire. Therefore, we separated the estimation of participant's own life experiences from the estimation of the experiences of others. The respective questions were asked on different sections as follows: In section B, the participants were asked to evaluate the frequency of various positive experiences in their friends' lives and to estimate the frequency of negative experiences in their friends' lives. In section E, which appeared few pages later, the same questions were asked with respect to the participant's own experiences.

   Thus, in section B participants were asked ten questions which evaluated the frequency of various positive experiences in their friends' lives (e.g. how often during the course of a week do they go out, read a book, watch a movie, etc.) and five questions in which they estimated the frequency of negative experiences in their friends' lives (e.g. how often during the course of a week are they in a bad mood, upset, sick, etc.).

C. **Social comparison:** Based on *Scale for Social Comparison Orientation* (Gibbons and Buunk, 1999). Participants were presented with eight statements and asked to indicate the degree to which they agree with each of them on a 6-point scale, from "strongly disagree" to "strongly agree". A high score indicates a high degree of social comparison. The reliability of the scale was evaluated using Cronbach's alpha measure (alpha=0.803).

   At the end of this section we added four questions on envy and the need to share.

D. **Happiness:** Based on *The Oxford Happiness Questionnaire (*Hills and Argyle, 2002). Respondents were presented with eight statements and were asked to what extent they agree with each of them on a 6-point scale as described above. A high score reflects a

higher degree of satisfaction with one's own life. The reliability of the scale was evaluated using Cronbach's alpha measure (alpha=0.715).

E. **Personal experiences:** Participants were asked about the frequency of ten positive experiences in their own lives (e.g. how often during the course of a week do they go out, read a book, watch a movie, etc.) and about five negative experiences in their own lives (e.g. how often during the course of a week are they in a bad mood, upset, sick, etc.).

   In our analysis, we constructed the variables own_positive and own_negative to measure the overall frequency of positive and negative experiences in one's life, respectively. Because the answers to the various questions on experiences are on different scales, in the construction of these variables, each question's original answer was transformed into a relative score, i.e. a percentile for that question, where the variable is the average of the 10 (or 5) questions' scores. Further, using sections B and E, we constructed the difference between the perception of others' experiences relative to one's own for positive and negative experiences separately. We then transformed the differences into percentiles for each question separately and averaged across questions. The variables were given the names Δ(pos)/Δ(neg), and a high value indicate a perception that others have more positive/negative experiences than oneself.

F. **Facebook use (section F):** Based on Ellison et al. (2007). This questionnaire asked about the frequency of Facebook use and the type of activities that users engage in. For example, participants were asked how often they check their Facebook account and how often they upload photos, tag, etc.

3.3 Analysis Method

We use two methods for estimating the effect of Facebook: a linear regression analysis and matching techniques. In the main analysis, we measure the differences between users and non-users (including some whose accounts are not active) but do not consider the manner in which Facebook is used, which is *endogenously* determined by the users. Subsequently, we analyze the employees' type of usage and report on the association between intensity of usage and the study's variables of interest.

Regression analysis

Following the vast literature on the measurement of happiness, we use the following demographic control variables: age, gender, education, income and family status (Ferrer-i-Carbonell and Frijters, 2004; Dolan et al., 2008). In addition to age's main effect on happiness, we also included its interaction with Facebook use. In line with previous findings, which showed that younger Facebook users are more susceptible to social influence than older ones (Aral and Walker, 2012), we account for potential variability in the effect of Facebook across different ages. We also devise an additional covariate: the estimated proportion of a subject's friends who use Facebook. This was motivated by the idea that if Facebook affects happiness and happiness is contagious (Fowler and Christakis, 2008), then one might want to control for potential peer influence (Bapna and Umyarov, 2015) while estimating Facebook's causal effect on happiness. All estimations of the Facebook effect are robust to its inclusion.

We start with the analysis of simple models to capture the total main effect of Facebook on users' happiness, social comparison and perception of others' lives. Then, we present the moderated mediation model (Preacher and Hayes, 2004; Hayes, 2013), which serves as the capstone of this study. According to the model (Figure 1), the effect of Facebook on happiness is mediated by social comparison; Age serves as a moderator for the effect of Facebook on social comparison

and the effect of social comparison on happiness is moderated by Δ(pos) - the perceptions of others' positive experiences as compared to one's own.

Matching

For robustness, we also use matching techniques, aiming to balance the observed characteristics of participants in treatment and control group, under the assumption that matching on the observed covariates also matches on the unobserved covariates, as they are correlated (Imbens, 2004). Specifically, we use propensity score matching (Rosenbaum and Rubin, 1983) with replacement, using nearest neighbor method, where the distance function is the *logit* function, regressing Facebook treatment on the covariates: age, gender, income, education and family status (Ho et al., 2007). We also perform matching using the *Mahalanobis* distance measure.

After obtaining balanced groups of users and non-users we re-estimate the effect of Facebook on happiness, social comparison and perception of others' lives (both with and without controlling for the demographic characteristics).

4. Results and Analysis

In what follows, we start with the analysis of simple models to capture the total main effect of Facebook on users' happiness, social comparison and perception of others' lives. Then, we move to the analysis of a comprehensive moderated mediation model.

The naïve (total) effect of Facebook on users' happiness is only marginally significant. However, accounting for the mediating effect of social comparison and the moderating effect of age and users' perception, we show that Facebook usage decreases happiness - just for the younger half of our sample and only if they believe that others have many more positive experiences than they do.

4.1 Baseline models: Happiness, social comparison and perception of others' lives

We found that Facebook use has a marginally significant negative effect on happiness using an ordinary least squares (OLS) regression model (B=-0.87 (0.47), p=0.068, n=135; see Table A1). Own positive and own negative experiences have a significant effect on happiness in the expected direction (own_positive: B=1.115 (0.4), p=0.006, n=135; own_negative: B=-1.133 (0.253), p<0.001, n=135) which provides a sanity check for these two variables. Although age had no significant main effect on happiness, it was found that age moderates the effect of Facebook on happiness. We calculated the effect for five age values: 19, 20, 23, 28 and 35, which correspond to the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles in our sample. We found that Facebook use had a significant negative effect on happiness only for the younger half of the subjects and no significant effect for the older subjects (see Table 1).

Table 1. Age's moderation of the effect of Facebook on happiness. The conditional effect of Facebook on Happiness, based on model 3 in Table A1, at 5 values of the moderator "Age", which correspond to the 10th, 25th, 50th, 75th and 90th percentiles.

Age	Effect	se	t	p
19	-0.372	0.162	-2.3	0.023
20	-0.346	0.15	-2.314	0.023
23	-0.268	0.122	-2.2	0.03
29	-0.112	0.132	-0.851	0.397
35	0.044	0.208	-0.21	0.834

In order to investigate the possible underlying mechanism of Facebook's effect on happiness, we estimate the participants' social comparison and their perceptions of their friends' positive experiences. We explore two explanations for the lower level of happiness: (i) Facebook users over-emphasize their positive experiences and underreport negative ones (Zhao et al., 2008), which *biases* the user's perceptions of others' lives relative to her own. Believing that others have better lives may undermine a user's happiness (Chou and Edge, 2012). Thus, our focus is not on

the perceptions of the "absolute" frequency of friends' positive and negative experiences, but rather Facebook's potential impact on the relative frequencies (friends vs. own). (ii) Facebook's architecture increases social comparison among its users, which may be the key since it has been shown that upward social comparison reduces happiness (Argyle, 2013). Thus, non-users do not have others' good lives slammed in their face and they can live in denial whereas for Facebook users, the positive experiences of others are more vivid and more frequently observed (i.e., hard to deny) which triggers upward social comparison (see Bamberger and Belogolovsky (2016) for a similar argument). We note that these two explanations are independent of each other: a biased perception may affect happiness even if one's social comparison level has not increased, while a higher level of upward social comparison may affect happiness even if one's perceptions haven't changed due to Facebook use. Next, we estimate the effect of using Facebook on these constructs in isolation and then build an integrated moderated mediation model.

Surprisingly, we find that Facebook usage has no impact on the Δ(pos) and Δ(neg) scores (Δ(pos): B=-0.021 (0.026), p=0.433, n=132, Δ(neg): B=0.019 (0.036), p=0.612, n=130, see Tables A2-A3). One might have expected that using Facebook would make a subject feel that others have more positive and less negative experiences than he/she does. However, it is also possible that subjects who use Facebook self-correct for this bias when thinking about particular experiences, based on the understanding that Facebook photos and reports do not represent reality. Yet, even if there is no bias when relating to the specific experiences of others, the vividness of others' positive experiences on Facebook might affect a user's feeling that others' lives are generally better than his/her own, in line with (Chou and Edge, 2012). This, in turn, might influence his/her subjective well-being, possibly through increased envy (Krasnova et al., 2013).

Social comparison, on the other hand, was found to be positively affected by Facebook usage (B=2.167 (0.685), p=0.002, n=133, Table A4). We did not find a main effect of age on social comparison (B=-0.022 (0.017), p=0.197, n=133). However, age's interaction with Facebook was

negative and significant (B=-0.074 (0.026), p=0.005, n=133) suggesting that the effect of Facebook usage decreases with age.

4.2. Moderated mediation model: The mediating effect of social comparison

Integrating the above findings, we constructed a comprehensive model to investigate Facebook's effect on happiness, both its direct effect and its indirect effect, mediated by social comparison (Figure 1).

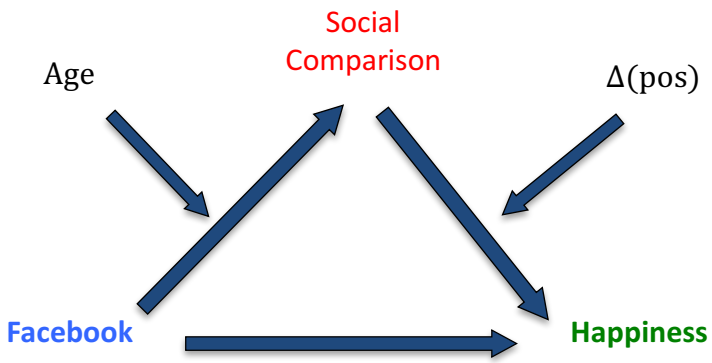


Figure 1: Mediated moderation model (Hayes 2013) for investigating the effect of Facebook on one's happiness via the mediating effect of social comparison. Age serves as a moderator for the effect of Facebook on social comparison and the effect of social comparison on happiness is moderated by Δ(pos) - the perceptions of others' positive experiences as compared to one's own.

Age serves as a moderator for the effect of Facebook on social comparison and consequently for the overall indirect effect on happiness. Furthermore, the effect of social comparison on happiness is moderated by the perceptions of others' positive experiences as compared to one's own (Δ(pos)). Both age and Δ(pos) moderators allow us to investigate the variable effect Facebook has on different age groups and on users with different levels of Δ(pos). We use the demographic variables as covariates. For robustness, we ran a number of variations of the model and found that using only some of the covariates does not alter the qualitative results. We also control for Δ(neg), for the sake of symmetry (the main effect of Δ(pos) is included in the model).

Eliminating it does not alter the qualitative results. We present the effects for five age values: 19, 20, 23, 28 and 35, which correspond to the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles in our sample. Similarly, the results for five values of Δ(pos) are reported. The full regression results appear in Table 2.

Table 2. The results of the mediated moderation model outlined in Figure 1. We find a significant effect of Facebook on social comparison and significant interactions – Facebook X age and Social comparison X Δ(pos) – which provide empirical evidence for the moderating effect of age and Δ(pos), respectively.

	Social comparison	*Happiness*
Facebook	2.05*** (0.710)	-0.081 (0.114)
Age	-0.043** (0.022)	
Facebook X Age	-0.072*** (0.027)	
Gender	-0.158 (0.178)	-0.154 (0.124)
Education	0.165 (0.113)	-0.048 (0.072)
Income	0.095 (0.067)	0.067* (0.04)
Family status	-0.547** (0.255)	0.17 (0.152)
Δ(neg)	-0.408 (0.43)	1.064*** (0.298)
Social comparison		0.324* (0.191)
Δ(pos)		2.871** (1.144)
Social comparison X Δ(pos)		-1.155*** (0.416)
R^2	0.143	0.255
N	129	129

*p<0.1, **p<.05, *** p<0.01

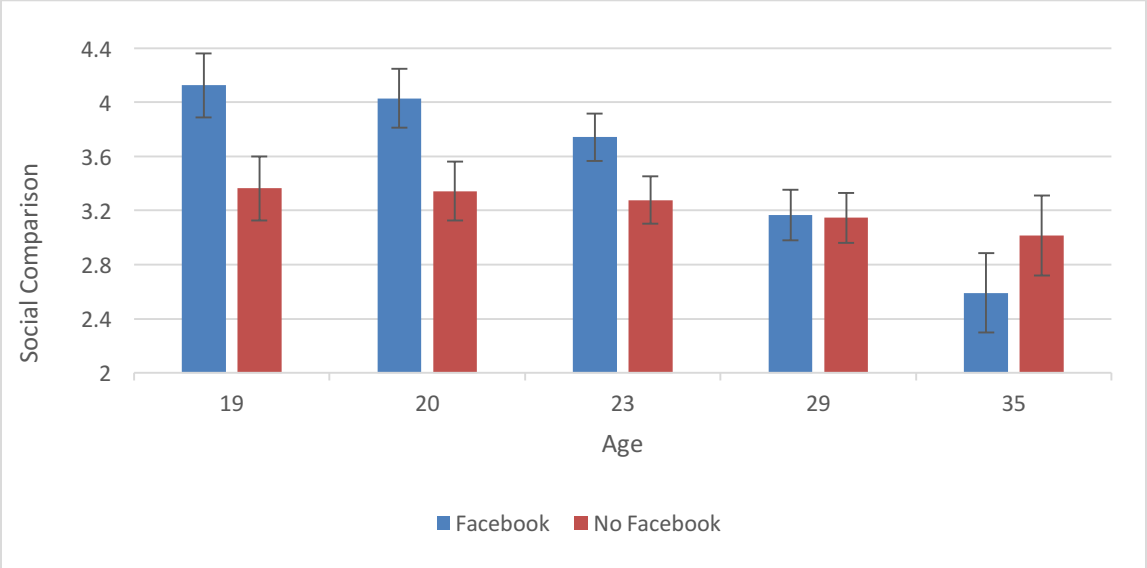
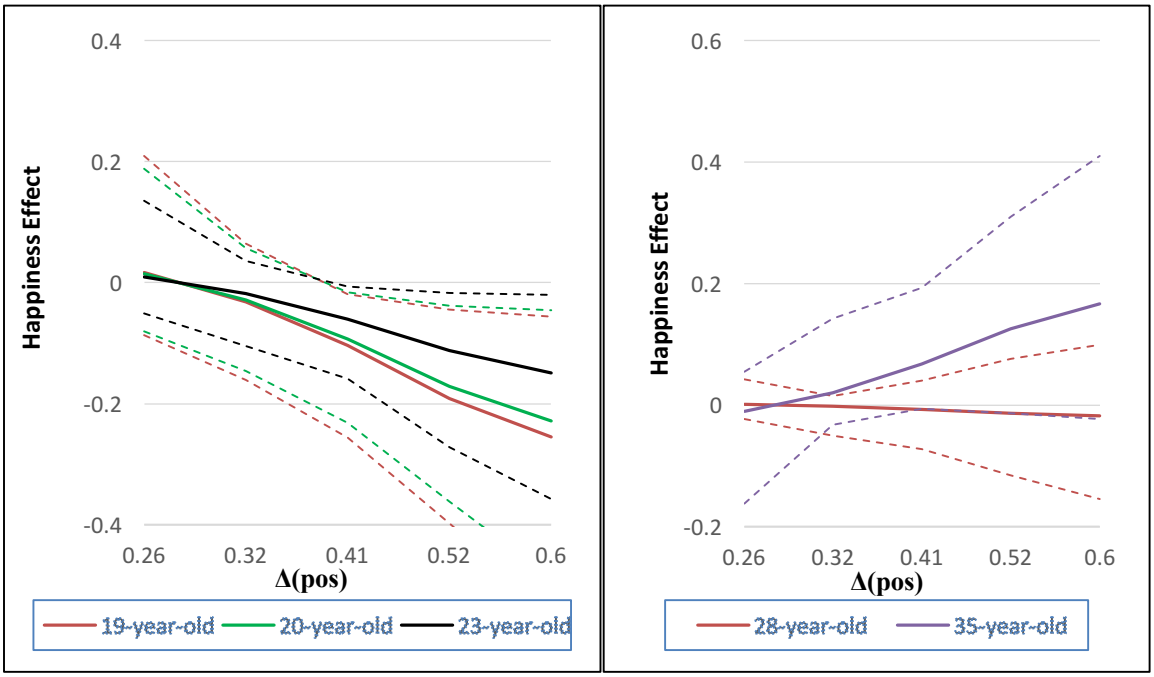


Figure 2: The Effect of Facebook on Social Comparison by Age. In order to illustrate the effect of Facebook, the estimated level of social comparison for Facebook users is compared to that of non-users, for each age group. The vertical lines represent the standard errors of the effects. The estimates of social comparison are based on setting covariates to their sample means. See Table A12 for the effect size.



(A) **(B)**

Figure 3: Indirect Effect of Facebook on Happiness moderated by Δ(pos) for different age groups. The solid lines represent the indirect effect of Facebook on happiness (mediated by social comparison) and the dashed lines show the 95% confidence intervals by the level of Δ(pos). Figure 3(A) shows the significant effect corresponding to the 10^{th}, 25^{th} and 50^{th} age percentiles (age 19, 20 and 23, respectively). Figure 3(B) shows no significant effect for the 75^{th} and 90^{th} age percentiles (age 28 and 35, respectively).

It was found that Facebook usage increases social comparison among the mid and lower age groups, i.e. for the 50th percentile and for the lower percentiles. For the 19, 20 and 23 year-old groups the effects are: 0.761 (0.236) (p=0.002, n=137), 0.687 (p=0.002, n=137) and 0.465 (p=0.009, n=137), respectively and there is no significant effect for 29 and 35 year-olds (p=0.91 and p=0.154, respectively; Figure 2 illustrates the magnitude of these effects). Social comparison, in turn, has a significant negative effect on happiness for high levels of Δ(pos), and no effect for low levels: For the 50th, 75th and 90th percentiles of Δ(pos), the average effects across age are -0.169 (p=0.007, n=129), -0.3 (p<0.001, n=129) and -0.395 (p<0.001, n=129), respectively. For the lower percentiles of Δ(pos) 25th and 10th, social comparison does not significantly affect happiness (p=0.422 and p=0.925, respectively). This finding suggests that increased social comparison *per se* does not necessarily undermine one's happiness which only occurs if one perceives herself/himself to have less positive experiences than her/his friends. In addition, we estimate the total indirect effect of Facebook usage on happiness for different age groups (Table A5).

Age plays an important role in our setting. We found a significant negative *indirect* effect on happiness for the 50th percentile age group and below, conditional on a high percentile of Δ(pos), and no effect for the older groups (Figure 3). Furthermore, for 19 year olds in the 90th percentile of Δ(pos), the estimated effect is -0.255 (0.122), whereas for 23 year olds with similar levels of Δ(pos) the effect is -0.15 (0.085), which is somewhat smaller. Similar patterns are observed for the 75th and 50th percentiles of Δ(pos). One possible explanation for the age-related differences is that younger participants are more susceptible to Facebook's influence because they rely on Facebook as a source of social information more than older adults, who are "trained" in gleaning social information from other, off-line sources. Another explanation considers the differences between younger and older adults in using Facebook's features. Indeed, we find that younger

users are more engaged in activities connected to others, such as comments and tags, rather than activities which focus on self, such as posting statuses and uploading photos (B=0.017 (0.007), p=0.025, n=87; Table A6), which may trigger social comparison. Note that we found no other age-related differences in the usage of Facebook in terms of frequency, intensity and engagement (Table A7).

In contrast, we found that Facebook usage has no *direct* effect on happiness (B=-0.081 (0.114), p=0.475, n=129; Table A5). Namely, Social comparison fully mediates the effect of Facebook on happiness. Furthermore, we tested a variation of the model and found that age does not moderate the direct effect of Facebook on Happiness.

4.3 Propensity score matching

We augment the analysis by implementing another approach to estimating the effect of Facebook usage: propensity score matching with replacement (Rosenbaum and Rubin, 1983; Dehejia and Wahba, 1999). This involved matching pairs of participants – a Facebook user and a non-user – according to similarity in age, gender, education, income and family status, thus generating two balanced groups (one of users and the other of non-users).

The matching process resulted in two balanced groups (with replacement: 30 non-users, 95 users), where the standard mean difference of the distance between the groups is below 0.007 and the standard mean difference of individual covariates is below 0.19 (and in particular below the 0.25 threshold suggested by Stuart (2010). See Table 3 for the detailed analysis. The treatment and control groups also obey the "common support" requirement, with substantial overlap of their propensity score distributions (Stuart, 2010), as illustrated in Figure 4.

Table 3: Balancing of Treatment and Control groups with *Logit* distance function. We conducted propensity score matching analysis, using nearest neighbor method with Distance = "logit" (with replacement). The table shows that after the matching the standard deviation of the mean standard between the users and non-users is small.

	Means FB Users	Before Matching			After Matching		
		Means FB Non-Users	SD FB Non-Users	SD Mean Diff.	Means FB Non-Users	SD FB Non-Users	SD Mean Diff.
Distance	0.719	0.544	0.229	**1.14**	0.718	0.154	**0.007**
Age	23.842	29.653	8.969	**-1.109**	23.632	5.392	**0.04**
Gender	1.453	1.306	0.466	**0.293**	1.358	0.488	**0.189**
Income	2.263	3.082	1.656	**-0.51**	2.158	1.639	**0.066**
Education	4.021	4.571	0.791	**-0.576**	3.958	0.978	**0.066**
Family	1.874	1.531	0.504	**0.819**	1.832	0.381	**0.101**

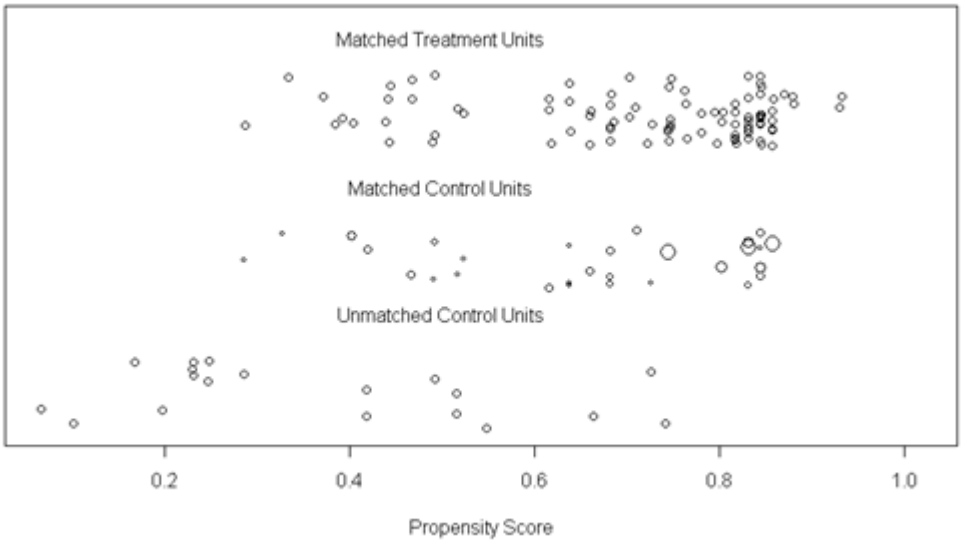


Figure 4: Distribution of propensity scores. The figure provides graphical evidence that the treatment and control groups obey the "common support" requirement, with substantial overlap of their propensity score distributions.

The estimated effect of using Facebook on happiness is -0.302 (0.134), using a weighted OLS regression (p=0.026, n=125). The estimated effect of using Facebook on social comparison is 0.541 (0.188), p=0.005, n=125. There is no significant effect of Facebook usage on the perceptions of others' lives compared to one's own, neither for positive experiences (B=-0.02,

p=0.46, n=125) nor for negative experiences (B=0.034, p=0.385, n=125). The mentioned effects are robust to the inclusion of the demographic covariates, which appear in Table 4.

Table 4. Estimation of the effect of Facebook on balanced Treatment and Control groups. We conducted weighted OLS analysis, regressing happiness, social comparison, Δ(pos) and Δ(neg) on Facebook usage and demographic covariates. The specifications of the propensity score matching are shown on Table 3. The results are aligned with our main analysis model showing a significant effect of Facebook on Happiness and Social Comparison, but no effect on Δ(pos) and Δ(neg).

	Happiness	Social Comparison	Δ(pos)	Δ(neg)
Facebook	-0.298** (0.137)	0.605*** (0.185)	-0.027 (0.028)	0.032 (0.04)
Age	-0.005 (0.018)	-0.059** (0.024)	-0.004 (0.004)	-0.002 (0.005)
Gender	-0.049 (0.145)	-0.445** (0.196)	0.06** (0.03)	0.041 (0.042)
Income	0.055 (0.054)	0.089 (0.073)	0.014 (0.011)	0.021 (0.016)
Education	-0.046 (0.083)	0.009 (0.112)	-0.009 (0.017)	-0.027 (0.024)
Family	-0.018 (0.173)	-0.466** (0.234)	0.006 (0.035)	-0.028 (0.05)
R^2	0.052	0.154	0.089	0.051
N	125	125	125	125

*p<0.1, **p<.05, *** p<0.01

For robustness, we also performed matching using the Mahalanobis distance measure (Rubin, 1980) and obtained qualitatively similar results: matching 33 non-users with 95 users (with replacement) resulted in balanced groups with standard mean difference of the individual covariates ranging between -0.13 and 0.05. The estimated effect of using Facebook on happiness is -0.266 (0.132), using a weighted OLS regression (p=0.046, n=128). The estimated effect of using Facebook on social comparison is 0.455 (0.169), p=0.008, n=128. There is no significant effect of Facebook usage on the perceptions of others' lives compared to one's own, neither for positive experiences (B=0.015, p=0.578, n=128) nor for negative experiences (B=0.039, p=0.289,

n=128). See Table A8 for balancing data and Table A9 for the detailed analysis. All the effects are robust to the exclusion of the demographic covariates.

5. Complementary Analysis

5.1 The role of the perception of others' negative experiences

We also examined a variation of our moderated mediation model in which the moderator Δ(pos) was replaced by Δ(neg). We found a weaker moderation role for the belief that others have more *negative* experiences than we do (see the attached supplementary material). In particular, there is an indirect negative effect of Facebook use on happiness only for high Δ(neg) scores. Although the Δ(neg) variable was found to be unaffected by Facebook use, the masking of negative experiences on Facebook in contrast to the vividness of others' positive experiences may lead one to downplay the possibility that others also have negative experiences. Hence, non-users with a given Δ(neg) score are more likely to benefit from *downward* comparison (off-platform) and to be happier than Facebook users with the same Δ(neg) score. Furthermore, the higher the score, the larger is the difference between users and non-users. The results of an additional model in which both Δ(pos) and Δ(neg) serve as moderators are presented in the attached supplementary materials.

5.2 Comparison to another group of Facebook users outside the organization

The generalization of our findings depends on the degree to which our sample is representative. In order to determine whether or not the level of social comparison and happiness or the manner in which the participants use Facebook is unique, we compared the results to those for a sample of undergraduate students at a university located near the organization's facility. A group of 175 undergraduate students (49% females) aged 18-35 (average age: 22.4) completed an identical questionnaire online. We focused on the 96% of those students who are Facebook users.

Although our original sample is unique in some ways (i.e. both users and non-users are employees of a security-related organization), we found that the social comparison and happiness score of the Facebook users in the organization do not differ from those of the parallel sample of students, after controlling for demographic variables (Social comparison: B=0.203 (0.123), p=0.102, n=252; Happiness: B=0.014 (0.093), p=0.878, n=253, see supplementary material). This suggests that our sample is not unique in these constructs.

The pattern of Facebook use, however, differs between the two samples. Comparing the Facebook users in the organization to those at the university, we found that the latter use Facebook more intensely: they feel more connected to Facebook, they spend more time on Facebook and they check their account more frequently (Table A10). Accordingly, their usage intensity score, which is based on these criteria, is higher than that of the organization's employees (B=0.645 (0.154), p<0.001, n=237, Table A11). Nonetheless, the employees' usage of Facebook is not negligible: they spend an average of 45 minutes on Facebook each day (where the median is about 20 minutes) and 80% of the users check their account at least once a day (42% check more than once). The students are also more active, as reflected in their answers to q6 in Section F **(**B=0.048 (0.02), p=0.019, n=237, Table A11). However, the balance between self-focused and others-focused activity, as reflected in q7, is the same for the organization's employees and the students (B=0.007 (0.025), p=0.777, n=237, Table A11). The students post more status updates but also like, tag others and comment more. Thus, it appears that the employees are somewhat more passive than the students. It might be, therefore, that it is the passive form of Facebook use which undermines users' subjective well-being, which is in line with previous studies (e.g. Verduyn et al., 2015).

5.3 The association between the intensity of using Facebook and the study indices

Finally, considering only Facebook users, we test whether the intensity of using Facebook is associated with happiness and social comparison in the same manner that using Facebook and not

using Facebook is associated with these constructs. As indicated in Table A13, an OLS estimation suggests that the intensity of using Facebook is related to social comparison but is neither related to happiness nor to Δ(pos) and Δ(neg). These results are robust to variations of the basic models reported in Table A13. Recall that the intensity of using Facebook is endogenously determined by the users and hence it is difficult to interpret an association between the intensity and our variables of interest.

6. Discussion

Our findings indicate that the use of Facebook does not impact the users' perception of others' lives: positive/negative experiences are not perceived as more/less frequent in others' lives as compared to one's own. This is somewhat surprising in view of the fact that Facebook is considered to be a tool for impression management and that users tend to portray an improved version of themselves (Zhao et al., 2008). These results imply that Facebook users may correct (unbias) their perception. The results should not be viewed as contradicting earlier findings, which suggest that people believe others have better lives than they do and that others are happier than they are (Chou and Edge, 2012). It is possible that when asked to estimate the frequency of a particular positive experience among others, a subject takes into account the exaggerated nature of Facebook posts while his/her overall perception of the lives and well-being of others, which is less concrete, is biased.

We found that Facebook usage increases general engagement in social comparison. The questionnaire was not specific to on-platform comparison, but rather measured the overall comparison orientation. We suggest that the Facebook user experience is designed in a way that promotes social comparison (particularly the friends feed), and may establish a tendency to compare oneself to others, also off-platform.

Furthermore, we found indications that users are less happy than non-users and showed that this could be explained by the increased engagement in social comparison, if combined with a belief that others' lives are richer in positive experiences than one's own. This finding is in the spirit of previous findings on increased envy due to Facebook usage and on Facebook's influence on subjective well-being (Krasnova et al., 2013; Tandoc et al., 2015). We note that the decline in happiness is only due to an *increase* in social comparison, whether using Δ(pos) or Δ(neg) as a moderator, and there is no direct effect of Facebook use on happiness.

An additional contribution of the study is related to our findings on the moderating effect of age. Most of the studies on the effect of Facebook use were conducted among relatively young participants, most of whom are students (Wenninger et al., 2014), and hence they were not able to extract the effect of age. Our setting allowed us to examine a wide range of ages (age 18-58, median: 24) and to isolate the effect of its interaction with Facebook use, on both social comparison and happiness. We found that only the young participants (age 18-23) in our sample were susceptible to the Facebook effect on social comparison and consequently on happiness.

This study is the first to our knowledge to use a natural experiment in order to measure the cumulative effect of prolonged Facebook use in a real-world setting. Although the assignment to each group (users and non-users) due to the organization's Facebook policy is not random as in a lab experiment, we argue that it significantly reduces selection bias. Moreover, our natural setting has some advantages over lab experiments, in which there may be a need to simulate Facebook use, participants may be aware of the research questions and perhaps only a momentary effect is being measured. More broadly, this paper demonstrates a potential negative effect of the usage of information and communication technologies, and in particular social network platforms such as Facebook, on its users' subjective well-being.

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Appendix

Questionnaire (translated from Hebrew)

Section A

1. Age
2. Sex: (1) male (2) female
3. Family status: a) married b) single v) widow/er d) divorced
4. Education (years): a) *≤8* b) *9-11* c) *12* d) *13-14* *e*) *≥15*
5. The average income per person in Israel is NIS 9,000 gross. How does your income (gross) compare to the average?
   a) Much below the average
   b) Slightly below the average
   c) Average
   d) Slightly above the average
   e) Much above the average

Section B

In this part of the questionnaire we ask you to assess the frequency with which your friends and acquaintances engage in certain activities and encounter certain situations, on average.
By "friends" we mean all the circles of friends and acquaintances you have built up over the years. By "family" we mean immediate family (spouse/partner, children, parents and siblings).

1. How many times a month do your friends go out (to parties, pubs, restaurants, etc.)? ____
2. How many books do your friends read a month? ____
3. How many movies do your friends watch per month at the cinema?____ at home? _____
4. How many times a month do your friends go out with their spouse/partner? ____
5. What percentage of your friends subscribe to an Israeli daily newspaper (printed or online)? ____
6. What percentage of your friends regularly read the non-Hebrew press (newspapers, news websites, blogs, subscribe to feeds, etc.)? ____
7. How many articles a month (press / internet) do your friends read? ____
8. How many times a month do your friends spend time on family activities? ____
9. How many times a month are your friends disappointed with food they have eaten at a restaurant / had delivered or prepared themselves? ___
10. How many times a month do your friends get sick? ____
11. How many times a month do your friends get upset at work? ____
12. How many times a month do your friends quarrel with a family member? ____
13. How many times a month do your friends get moody? ____
14. How many times a year do your friends go on vacation in Israel or abroad? ____

15. On each of questions 1-14 above, we want to know how accurate you believe your answer is. Circle the numbers of the questions for which you believe your assessment is accurate plus/minus 1.
How many questions have you circled? ____

Section C

Please indicate the degree to which you agree with each of the following statements on a scale of 1-6, where 1 means strongly disagree and 6 means strongly agree.
1. I often compare myself with others with respect to what I have accomplished in life
2. I always pay a lot of attention to how I do things compared with how others do things
3. I often compare how my loved ones (spouse/partner, family members, etc.) are doing with how others are doing
4. I am not the type of person who is always making comparisons with others

5. If I want to find out how well I have done something, I compare what I have done with what others have done
6. I often compare how I am doing socially (e.g., social skills, popularity) with other people
7. If I want to form an opinion about something, I try to find out what others think about it
8. I never consider my situation in life to that of other people
9. I often see others doing something fun and feel sorry I do not do it as well
10. After an enjoyable activity I feel the need to share the experience
11. When I hear about the positive experiences of acquaintances, I get ideas about similar things I can do myself
12. Sometimes I find it hard to see that other people have achieved things I have still not been able to achieve

Section D

Please indicate how much you agree with each of the following statements on a scale of 1-6, where 1 means strongly disagree and 6 means strongly agree.

1. I don't feel particularly pleased with the way I am
2. I feel that life is very rewarding
3. I am quite satisfied with everything in my life
4. I don't think I look attractive
5. I find beauty in different things
6. I can adapt myself to what I want
7. I feel fully alert
8. I do not have happy memories of the past

Section E

In this section, we want you to estimate the frequency with which you find yourself in certain situations and engage in various activities in your daily life, on average. Please try to make your evaluations as accurate as possible.

1. How many times a month do you go out (to parties, pubs, restaurants, etc.)? ____
2. How many books do you read a month? ____
3. How many movies do you watch a month at the cinema? _____ at home?_____
4. How many times a month do you go out with your spouse/partner? ____
5. Do you subscribe to an Israeli daily newspaper (printed or online)? ____
6. Do you regularly read the non-Hebrew press (newspapers, news websites, blogs, subscribe to feeds, etc.)? ____
7. How many articles a month (press / internet) do you read? ____
8. How many times a month you spend time on family activities?
9. How many times a month are you disappointed with food you have eaten at a restaurant / had delivered or prepared by yourself? ____
10. How many times a month do you get sick? ____
11. How many times a month do you get upset at work? ____
12. How many times a month do you quarrel with a family member? ____
13. How many times a month do you get moody? ____
14. How many times a year do you go on vacation in Israel or abroad? ____

Section F

In this section, we want to know about your use of Facebook.

1. Do you have a Facebook account?
    a) Yes. I have an active account.
    b) I have an account but it is not active. (How long has the account been inactive?_____)
    c) I had a Facebook account but closed it. (How long ago?_____)
    d) No. I have never had a Facebook account.

2. What proportion of your friends use Facebook? If you are not sure, give your best estimate _____%

This is the end of the questionnaire for those of you who do not have a Facebook account.

3. Please indicate how much you agree with each of the following statements on a scale of 1-6, where 1 means strongly disagree and 6 means strongly agree.

a) Facebook is part of my daily activity
b) I am proud to tell people I'm on Facebook
c) Facebook has become part of my daily routine
d) I feel out of touch when I haven't logged onto Facebook for a while
e) I feel I am part of the Facebook community
f) I would be sorry if Facebook shut down

4. How often on average do you check your Facebook account?

a) Every few minutes
b) Every hour
c) Several times a day
d) Every day
e) Every few days
f) Once a week
g) Less than once a week

5. In the past week, on average, approximately how much time a day have you spent actively using Facebook? ___ (minutes)

6. Specify the extent to which you use Facebook for each of the following activities, where 1 means that you do not use Facebook for this activity and 6 means that you use Facebook mostly for this activity.

a) Look at pictures posted by others
b) Read articles / reports
c) Watch amusing videos
d) Know what is happening to people who are close to me
e) Know about social events that are to take place
f) Keep up on what is happening in the country and on the views of the public about what is happening
g) Keep in touch with distant acquaintances
h) Keep in touch with social and professional groups
i) Share my thoughts and my views

7. To what extent do you perform the following actions on Facebook, where 1 means not at all and 6 means very frequently?

a) Post statuses
b) Upload photos and videos
c) Like
d) Comments
e) Tag places, friends, etc.

Table A1: The effect of Facebook on happiness

The following table presents an OLS estimation for 4 different models, where happiness level is the dependent variable and the explanatory variables appear on the left column.

	Happiness (1)	Happiness (2)	Happiness (3)	Happiness (4)
Age	-0.018 (0.013)	-0.015 (0.013)	-0.015 (0.012)	-0.12 (0.12)
Gender	-0.182 (0.127)	-0.177 (0.131)	-0.027 (0.123)	-0.27 (0.123)
Education	-0.106 (0.079)	-0.098 (0.080)	-0.148** (0.074)	-0.116 (0.071)
Income	0.064 (0.048)	0.059 (0.049)	0.065 (0.044)	0.079 (0.044)
Family status	0.035 (0.157)	-0.049 (0.16)	0.069 (0.17)	0.045 (0.17)
Facebook	-0.769 (0.51)	-0.758 (0.511)	-0.867* (0.471)	-0.207* (0.115)
Facebook x Age	0.025 (0.019)	0.023 (0.020)	0.026 (0.018)	
% Friends Facebook		0.004 (0.004)		
Own positive			1.115*** (0.400)	1.178*** (0.399)
Own negative			-1.133*** (0.252)	-1.128*** (0.254)
R^2	0.062	0.071	0.234	0.221
N	136	134	134	134

*p<0.1, **p<.05, *** p<0.01

Table A2: The effect of Facebook on the indices Δ(pos) and Δ(neg)

The following table presents the OLS estimation of 3 models in which Δ(pos) is the dependent variable and 3 models in which Δ(neg) is the dependent variable, where the explanatory variables are the demographic variables and Facebook usage. We also explore the interaction of Facebook usage and age. We found that Facebook have no significant effect on these two indices.

	Δ(pos) (1)	Δ(pos) (2)	Δ(pos) (3)	Δ(neg) (4)	Δ(neg) (5)	Δ(neg) (6)
Age	-0.002 (0.003)	-0.002 (0.003)	-0.002 (0.003)	-0.006 (0.005)	-0.006 (0.005)	-0.007 (0.005)
Gender	0.038 (0.028)	0.036 (0.029)	0.038 (0.028)	0.004 (0.038)	0.001 (0.039)	0.005 (0.038)
Education	-0.009 (0.016)	-0.009 (0.017)	-0.004 (0.017)	-0.035 (0.023)	-0.037 (0.024)	-0.039 (0.024)
Income	0.010 (0.010)	0.010 (0.010)	0.013 (0.010)	0.015 (0.014)	0.014 (0.015)	0.013 (0.015)
Family	0.018 (0.033)	0.018 (0.034)	0.018 (0.033)	-0.105* (0.055)	-0.104* (0.056)	-0.102* (0.055)
Facebook	-0.021 (0.026)	-0.020 (0.027)	0.096 (0.108)	0.019 (0.036)	0.021 (0.037)	- 0.079 (0.153)
% Friends Facebook		0.000 (0.001)			0.000 (0.001)	
Facebook X Age			- 0.005 (0.004)			0.004 (0.006)
R^2	0.051	0.050	0.060	0.067	0.068	0.070
N	133	131	132	130	129	130

*p<0.1, **p<.05, *** p<0.01

Table A3: The effect of Facebook on the perception of others' experiences compared to own

We calculated, for each question in Section B and its parallel in Section E, the difference between the estimated frequency with which friends experience something and the frequency with which the participant experiences it. We obtained 15 differences: diffpos1-diffpos10 and diffneg1-diffneg5. Multivariate analysis, using the demographic variables as covariates, indicated that Facebook usage does not affect neither the set diffpos1-diffpos10 (Pillai's Trace = 0.08, Wilks' Lambda = 0.92, Hotelling's Trace = 0.087, Roy's Largest Root = 0.087, F=0.807, p=0.622) nor the set diffneg1-diffneg5 (Pillai's Trace = 0.059, Wilks' Lambda = 0.941, Hotelling's Trace = 0.063, Roy's Largest Root = 0.063, F=1.41, p=0.226). Similar qualitative results were obtained when allowing for an interaction of Facebook and age.

Using a separate OLS estimation for each of the above differences, it turned out that using Facebook significantly affects only three out of those 15 differences: diffpos3 (q3a), diffpos8 (q7) and diffneg3 (q11), and only when allowing for an interaction of Facebook and age. The estimations appear in the table below.

	difpos3 (q3a)	difpos8 (q7)	difneg3 (q11)
Age	-0.008 (0.026)	0.043 (2.165)	-0.413 (0.363)
Gender	-0.234 (0.265)	4.084 (20.806)	2.106 (2.978)
Education	-0.237 (0.161)	-11.347 (12.404)	-1.355 (1.870)
Income	0.182* (0.099)	8.694 (7.545)	-1.884 (1.142)
Family	-0.358 (0.032)	39.537 (24.529)	-5.491 (4.366)
Facebook	2.054** (1.035)	-163.561** (81.671)	-26.98** (11.801)
Facebook X Age	-0.076* (0.039)	6.440** (3.116)	0.942** (0.450)
R^2	0.082	0.078	0.084
N	133	128	131

*p<0.1, **p<.05, *** p<0.01

Table A4: The effect of Facebook on social comparison

The following table presents the OLS estimation for 5 different models, where social comparison level is the dependent variable. The explanatory variables appear in the left column.

	Social Comparison (1)	Social Comparison (2)	Social Comparison (3)	Social Comparison (4)	Social Comparison (5)
Age	-0.032* (0.017)	-0.022 (0.017)	-0.029* (0.017)	-0.039** (0.017)	-0.025 (0.018)
Gender	-0.250 (0.173)	-0.267 (0.169)	-0.250 (0.172)	-0.238 (0.176)	-0.372** (0.177)
Education	0.031 (0.104)	0.117 (0.106)	0.117 (0.106)	0.031 (0.104)	0.150 (0.107)
Income	0.016 (0.064)	0.060 (0.064)	0.083 (0.064)	0.039 (0.064)	0.065 (0.065)
Family status	-0.333 (0.213)	-0.331 (0.207)	-0.323 (0.207)	-0.316 (0.213)	-0.415 (0.244)
Facebook	0.276 (0.168)	2.167*** (0.685)	2.129 *** (0.675)	0.290* (0.17)	2.235*** (0.685)
Facebook x Age		-0.074*** (0.026)	-0.072*** (0.026)		-0.076*** (0.026)
% Friends Facebook			-0.003 (0.005)	-0.003 (0.005)	
Own positive					-0.690 (0.579)
Own negative					0.790** (0.364)
R^2	0.072	0.126	0.141	0.086	0.170
N	133	136	133	136	133

*p<0.1, **p<.05, *** p<0.01

Table A5: The estimated indirect effect of Facebook on happiness

Based on the estimation that appears on Table 2, the following table summarizes the indirect effect of Facebook on happiness given the different values of the two moderators (the values for age and Δ(pos) moderators that correspond to the 10th, 25th, 50th, 75th, and 90th percentiles).

Age	Δ(pos)	Effect	Boot SE	BootLLCI	BootULCI
19	0.26	0.016	0.067	-0.087	0.209
19	0.32	-0.032	0.053	-0.161	0.064
19	0.41	-0.104	0.056	-0.256	-0.019
19	0.52	-0.191	0.090	-0.398	-0.045
19	0.6	-0.255	0.122	-0.544	-0.056
20	0.26	0.015	0.060	-0.080	0.188
20	0.32	-0.028	0.048	-0.146	0.057
20	0.41	-0.093	0.051	-0.231	-0.016
20	0.52	-0.172	0.083	-0.362	-0.039
20	0.6	-0.229	0.112	-0.487	-0.045
23	0.26	0.010	0.041	-0.051	0.135
23	0.32	-0.019	0.032	-0.105	0.036
23	0.41	-0.061	0.037	-0.159	-0.007
23	0.52	-0.112	0.063	-0.271	-0.017
23	0.6	-0.150	0.085	-0.357	-0.020
28	0.26	0.001	0.016	-0.023	0.042
28	0.32	-0.002	0.014	-0.050	0.015
28	0.41	-0.007	0.026	-0.072	0.040
28	0.52	-0.013	0.047	-0.115	0.076
28	0.6	-0.018	0.064	-0.155	0.100
35	0.26	-0.011	0.048	-0.162	0.055
35	0.32	0.021	0.040	-0.032	0.142
35	0.41	0.068	0.050	-0.006	0.193
35	0.52	0.125	0.081	-0.014	0.310
35	0.6	0.167	0.109	-0.023	0.410

*p<0.1, **p<.05, *** p<0.01

Table A6: Facebook usage – The effect of age

The following table presents the effect of age on the type of usage, considering only at the sub-sample of users among the employees. In an OLS estimation, there was no effect of age on the association to Facebook, the time spent on Facebook, the account checking frequency or the overall intensity (which combines the last three aspects). Moreover, there is no significant effect of age on the measure of active vs. passive usage. The only significant effect of age is on the measure of self vs, others: young users' activities on Facebook appear to be more focused on others (liking, tagging and commenting more than posting photos and updating status). Similar results were obtained when comparing the group of 24 years old or less with the older group of participants as described in Table A7.

	Intensity	Passive vs. active	Self vs. others
Age	0.032 (0.042)	-0.081 (0.060)	0.017** (0.007)
Gender	0.462 (0.278)	0.172 (0.390)	0.017 (0.048)
Education	-0.076 (0.170)	-0.143 (0.239)	0.014 (0.029)
Income	-0.006 (0.103)	0.088 (0.148)	-0.031* (0.018)
Family	-0.211 (0.332)	-0.227 (0.471)	0.011 (0.057)
R^2	0.062	0.065	0.094
N	87	87	87

*p<0.1, **p<.05, *** p<0.01

Table A7: Facebook usage - Young vs. old employees

Considering only Facebook users in the organization, the following table compares the type of usage and intensity of usage of the group of young users (24 and younger) with that of older users (25 and older).

		N	Mean	SD	t	p
Self vs. others	25 & older	31	0.528	0.243	2.001	0.048
	24 & younger	62	0.448	0.14		
Association	25 & older	32	19.250	8.144	1.001	0.320
	24 & younger	62	17.613	7.175		
Frequency	25 & older	32	3.97	0.933	-1.041	0.301
	24 & younger	62	4.18	0.915		
Facebook intensity	25 & older	30	3.298	1.196	0.77	0.443
	24 & younger	62	3.110	1.045		
Passive vs. active	25 & older	32	2.804	1.286	-1.169	0.245
	24 & younger	61	3.198	1.666		

Table A8: Balancing of Treatment and Control groups with Mahalanobis distance function

For robustness, we conducted additional propensity score matching analysis, using nearest neighbor method with Distance = "mahalanobis" (with replacement). The table shows that after the matching the standard deviation of the mean standard between the users and non-users is small.

	Means FB Users	Before Matching			After Matching		
		Means FB Non-Users	SD FB Non-Users	SD Mean Diff.	Means FB Non-Users	SD FB Non-Users	SD Mean Diff.
Age	23.842	29.65	8.969	**-1.109**	24.253	5.384	**-0.078**
Gender	1.453	1.306	0.466	**0.293**	1.432	0.503	**0.042**
Income	2.263	3.082	1.656	**-0.51**	2.274	1.721	**-0.007**
Education	4.021	4.571	0.791	**-0.576**	4.147	0.977	**-0.132**
Family	1.874	1.531	0.504	**0.8192**	1.853	0.36	**0.05**

Table A9: Estimation of the effect of Facebook on balanced Treatment and Control groups

We conducted weighted OLS analysis, regressing happiness, social comparison, Δ(pos) and Δ(neg) on Facebook usage and demographic covariates. The specifications of the propensity score matching are shown on Table S16. The results are, again, aligned with our main analysis model showing a significant effect of Facebook on Happiness and Social Comparison, but no effect on Δ(pos) and Δ(neg).

	Happiness	Social Comparison	Δ(pos)	Δ(neg)
Facebook	-0.266**	0.455***	0.015	0.039
	(0.132)	(0.169)	(0.026)	(0.037)
Age	-0.009	-0.068***	-0.005	-0.005
	(0.018)	(0.023)	(0.004)	(0.005)
Gender	-0.085	-0.371**	0.043	0.016
	(0.145)	(0.186)	(0.029)	(0.041)
Income	0.047	0.096	0.018*	0.020
	(0.053)	(0.068)	(0.011)	(0.015)
Education	-0.035	0.099	-0.008	-0.025
	(0.084)	(0.108)	(0.017)	(0.024)
Family	-0.059	-0.319	0.009	-0.042
	(0.171)	(0.219)	(0.034)	(0.048)
R^2	0.043	0.153	0.067	0.048
N	128	128	128	128

*p<0.1, **p<.05, *** p<0.01

Table A10: Facebook usage – Employees and students

The following table presents a number of measures of intensity and type of Facebook usage, for the two sub-samples of users: employees and students who are under 29 (such that the average age of the two sub-samples is similar: 21.975 for the employees and 22.335 for the students). All measures are based on the answers to Section F.

It appears that the students use Facebook more intensely than the employees in the following manners: They have stronger the association with Facebook (question 3), they spend more time on Facebook (question 5, minutes per day), they check their account more frequently (question 4) and their overall intensity of usage (which combine the last three aspects) is higher.

They are also more active according to the measure of *active vs. passive*: Question 6 includes 9 questions, some reflect active usage (e.g. connecting) and some reflect passive activities (e.g. learning). The measure of the active vs. passive is 2*(q7+q8+q9)/(q1-q6), namely higher score indicates that the user is more active. However, the balance between self-focused and others-focused activity (or initiate vs. reactive) is the same for the two samples as indicated by the measure of *self vs. others.* This measure was created from the 5 answers to question 7 in Section F: (q1+q2)/(q3+q4+q5).

		N	Mean	SD
Association	Employees	79	17.962	7.535
	Students	165	21.442	6.885
Time	Employees	78	44.64	76.297
	Students	165	101.64	141.577
Frequency	Employees	79	4.2	0.883
	Students	165	5.08	0.933
Facebook intensity	Employees	78	3.162	1.101
	Students	165	3.803	0.993
Active vs. passive	Employees	78	3.117	1.592
	Students	165	2.55	0.979
Self vs. others	Employees	78	0.467	0.169
	Students	165	0.462	0.164

Table A11: Differences in Facebook usage – Employees and students – Regression analysis

The following table presents the estimation results of three OLS models. The dependent variables are: Intensity of usage, a measure of active vs. passive usage and a measure of self-focused vs. others-focused usage. The results show that the students use Facebook more intensely than the employees. They are also more active vs. passive. However, the balance between self-focused and others-focused activity is the same for the two samples.

	Intensity	Active vs. passive	Self vs. others
Age	0.013 (0.032)	0.010** (0.004)	0.08 (0.005)
Gender	-0.031 (0.139)	0.013 (0.018)	0.036 (0.022)
Education	0.045 (0.095)	0.014 (0.013)	0.025* (0.015)
Income	0.013 (0.071)	0.008 (0.009)	-0.020* (0.011)
Family	-0.198 (0.293)	0.021 (0.039)	-0.005 (0.047)
Students	0.645*** (0.154)	0.048** (0.020)	-0.007 (0.025)
R^2	0.079	0.066	0.066
N	237	237	237

*p<0.1, **p<.05, *** p<0.01

Table A12: The estimated effect of Facebook on social comparison

Based on the estimation that appears on Table 2, the following table presents the conditional direct effect of Facebook on social comparison at 5 values of the moderator age that correspond to the 10th, 25th, 50th, 75th, and 90th percentiles.

Age	Effect	se	t	p
19	0.7611	0.2361	3.2237	0.0016
20	0.6871	0.218	3.1514	0.002
23	0.4651	0.1762	2.6392	0.0093
29	0.0211	0.1862	0.1135	0.9098
35	-0.4229	0.2951	-1.4328	0.1543

Table A13: The association between the intensity of using Facebook and the study indices

Considering only Facebook users, we analyze the employees' type of usage and report on the association between intensity of usage and the study's variables of interest.

	Social comparison	Happiness	Δ(pos)	Δ(neg)
Age	-0.126***	0.016	-0.007	0.002
	(0.032)	(0.024)	(0.005)	(0.009)
Gender	-0.434**	-0.104	0.080**	0.022
	(0.209)	(0.159)	(0.037)	(0.051)
Education	0.073	-0.104	0.007	-0.051*
	(0.128)	(0.096)	(0.022)	(0.031)
Income	0.131	0.049	0.017	0.021
	(0.077)	(0.058)	(0.013)	(0.019)
Family	-0.513**	-0.001	0.014	-0.035
	(0.245)	(0.187)	(0.043)	(0.079)
Facebook intensity	0.186**	-0.089	-0.022	-0.024
	(0.082)	(0.062)	(0.014)	(0.020)
R^2	0.214	0.069	0.124	0.077
N	86	87	86	85

*p<0.1, **p<.05, *** p<0.01