RUNNING HEAD: O'CONNOR & ROSENBLOOD (1996) REPLICATION

The Regulation of Social Interaction in Everyday Life:

A Replication and Extension of O'Connor and Rosenblood (1996)

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Abstract

The present investigation replicates O'Connor and Rosenblood's (1996) experience sampling study of the homeostatic regulation of social interaction, and addresses the statistical limitations of the original study. Using community ($N = 62$) and student ($N = 54$) samples, multilevel model results indicated that desire to be alone reduces future likelihood of social interaction ($n = 2,747$), which replicates the original study's findings. Results suggest that social interaction is regulated within each day; yesterday's desire for contact is unassociated with today's interaction frequency. Individuals' optimal social interaction state changed from no-contact desired to contact desired over the day, but results did not support the original study's claim regarding social satiation. Future directions for the study of social interaction regulation are discussed.

Keywords: affiliation motivation; experience sampling method; multi-level modeling; replication study; social interaction

The Regulation of Social Interaction in Everyday Life:

A Replication and Extension of O'Connor and Rosenblood (1996)

Twenty years ago, O'Connor and Rosenblood (1996) introduced their innovative study of social interaction by stating, "The need for affiliation is generally believed to motivate individuals to seek out social contact at times and solitude at other times" (p. 513). Motivational research has long recognized the fundamental need to affiliate, or to "co-operate and converse sociably with others" (Murray, 1938/1970, p. 369). Throughout the last century, the theoretical development of the affiliation motivation increasingly focused on social interaction (Hill, 1987; 2008). Yet, as O'Connor and Rosenblood recognized, such work tended to focus on between-person differences, such as personality traits, rather than within-person regulation of social interaction. The most important contributions of O'Connor and Rosenblood were theoretically linking the social affiliation model (SAM) to homeostatic regulatory processes, and testing the model with a then-novel experience sampling method (ESM).

According to Google Scholar (2016), the original article has been cited 46 times, often as evidence of the homeostatic regulation of social interaction. Yet, claims regarding the regulation of social interaction within a homeostatic system have not been replicated. The primary goal of the present investigation is the replication of O'Connor and Rosenblood (1996). There are three reasons such a replication is justified. Although replication has been a core principle of social scientific inquiry in general, there has been a renewed discussion on the importance of replication (Funder, Levine, Mackie, Morf, Vazire, & West, 2014). Furthermore, advances in statistical methods, especially multilevel modeling techniques, justify the replication of this particular investigation. To test hypotheses, O'Connor and Rosenblood used a transition-frequency matrix, which collapsed variation in the independent variable (i.e., desire to interact)

into dichotomous and trichotomous outcomes. Analysis of ESM, where individuals report on behavior, emotions, or attitudes several times within a day, over several days, has changed dramatically in the last 20 years due to the development and adoption of multilevel modeling techniques, an increase in computation power, and the ease of using mobile devices to collect data (Bolger & Laurenceau, 2015). Finally, replication can further support the study's central claims and identify boundary conditions of the applicability of findings (Walther, 2010).

The present investigation will examine the effect of social state and desired social state on future social interaction, accounting for within- and between-person variation and the non-independence of observations. The present investigation will extend O'Connor and Rosenblood's (1996) SAM to investigate the nature of satiation within a homeostatic framework, and the time scale of the effects (i.e., within vs. between days). It will also examine two different samples (i.e., college student, community adult) to determine if the relationships between variables are moderated by stage of life.

Social Affiliation Model

As articulated by O'Connor and Rosenblood (1996), SAM is a homeostatic model of social interaction wherein individuals seek out social contact in a manner consistent with an internal optimal range. Individuals regulate their social contact in a way that reflects an underlying need for affiliation and the amount of social interaction previously engaged in. SAM was an elaboration of prior human and animal models, including Latane and Werner's (1978) sociostat, which suggested that social deprivation increases social stimulation seeking and social satiation reduces further social contact in rats. Working from an analogy of caloric intake, O'Connor and Rosenblood suggest that social interactions provide individuals with different amounts of "social calories" as a function of the interaction partner, the type and length of

interaction. The need to social affiliate is thought to be relatively stable over time, and between-individual variation in the amount of and desire for social interaction was also assumed.

Drawing from this model, the original study found support for several hypotheses, including that desire for solitude at prior times was predictive of solitude at future times, and desire for social interaction at prior times was predictive of interaction at future times. Although O'Connor and Rosenblood (1996) did not make specific predictions about how long the effect of desire for any given social state would last, they found "individuals are motivated to maintain specific affiliative states in a manner consistent with a homeostatic process over a period of at least 4 hours" (p. 520). By contrast, the continuation of activities hypotheses, which suggested that people would continue to remain in interactive states from one time to the other regardless of desire, was not supported. O'Connor and Rosenblood (1996) concluded that despite extrinsic constraints or a need to continue ongoing social activities, individuals "continue in elected social circumstances because of a drive to do so" (p. 520). If an individual wishes to be alone, he or she is more likely to be alone at a future time, but if that person wishes to be in contact with others, he or she is more likely to be in contact at a future time. The original study demonstrated that desire to interact (or be alone) at prior time points regulates future social interaction state over a period of 1-4 hours within a day, while social interaction state at prior time points did not explain variation in social interaction at future time points.

Although many aspects of social interaction have been investigated, they often focus on the interaction itself using event contingent reporting, such as the Rochester Interaction Record (Wheeler & Nezlek, 1977) or Iowa Communication Record (Leatham & Duck, 1990). These studies have documented the content or type of social interactions, and its association with emotional well-being and relatedness (e.g., Duck, 1991; Reis, Sheldon, Gable, Roscoe, & Ryan,

2000). Yet, beyond O'Connor and Rosenblood's original study, research on the regulation of

social interaction itself has been sparse. Although the desire to be in social contact has been

identified as a common desire of somewhat strong intensity (Hofmann, Vohs, & Baumeister,

2012), the way in which it is regulated remains relatively understudied. A related line of ongoing

research has explored between-person differences in and the stability of the affiliation and

intimacy motivations (Hill, 1987; 2008). Those with higher chronic affiliation motivation engage

in more social interactions, including visiting friends and making phone calls, and are more

likely to desire social interaction when they are alone (Hill, 2008). Although the need to affiliate

as trait is theoretically thought to function based on homeostatic principles, very little work has

given attention to the nature of that regulation within a day or over time.

Conceptually, the need to belong (Baumeister & Leary, 1995) is similar to the affiliation

motivation in terms of the need to engage socially with others, and it includes the development

and maintenance of close relationships. When measured at the trait level, the need to belong is

associated with a preference for engaging in joint activities and having more strong and weak tie

relationships, but not necessarily a greater likelihood of being alone or in contact with others

(Leary & Kelly, 2008). The belongingness motivation is associated with highly valuing social

connections and prioritizing interpersonal relationships, particularly voluntary close relationships

like friendships (Leary & Kelly, 2008). Furthermore, social inclusion has the potential to

temporarily diminish the intensity of the need to belong, while social exclusion intensifies the

drive (DeWall, Baumeister, & Vohs, 2008). When experiencing social exclusion, those high in

the need to belong are more likely to reminisce about close relational partners and use Facebook

more (Leary & Kelly, 2008). For the most part, however, research in support of the need to

belong has examined the cognitive and emotional reactions to social inclusion/exclusion, but

generally has not focused on social interactions generally or the regulation of interactions specifically (Gere & MacDonald, 2010). Due to a heavier focus on emotional and behavioral responses to exclusion, very little research has explored seeking or avoiding social interaction in response to regulating affiliation or belongingness needs. Instead, self-regulation is often studied in response to coping with unwanted emotions accompanying exclusion, rather than regulating social interaction itself (Gere & McDonald, 2010).

Extensions of SAM

O'Connor and Rosenblood (1996) recommended several avenues for further inquiry. They queried whether homeostatic processes would function in a similar manner for individuals who were higher or lower in affiliation on average. That is, they recognized the importance of accounting for between-person variation in social interaction, although they did not account for this variation in their own model. They encouraged researchers to explore the nature of satiated states (i.e., wish to be in contact and are; do not wish to be in contact and are alone), revealing "participants made significantly fewer transitions to the same social circumstance when they had previously been in nondesired states than when they had been in elected states" (O'Connor & Rosenblood, 1996, p. 520). That is, the influence of current social interaction on future social interaction was moderated by desire to interact. This argument suggests the effect of social interaction on future interaction is moderated by desire to be alone. O'Connor and Rosenblood (1996) were also concerned that they might have used an "inappropriately short interval" of time between experience samples in their study (i.e., 70 minutes), and sought to identify the appropriate time window for studying interaction regulation (p. 520).

Other questions about social regulation could also be considered. For example, is social interaction regulated within a day or between days phenomenon, or is there any lingering effect

of social interaction from the prior day on a person's social interaction processes today? The answer to these questions has both theoretical and methodological value. This raises the practical question, when using multi-day ESM should researchers carry over experiences or interactions from the night before to the following morning? Documenting the appropriate time scale of homeostatic processes through analysis of within-person variation is a critical component of understanding the appropriate frequency of measurement and type of analysis when studying daily life processes (Deboeck, 2013). Furthermore, to better understand the regulation of social interaction, it is useful to consider whether there is a shape of interaction and desire to interact within a day. ESM has the ability to examine how a variable fluctuates from morning to night (Bolger, Davis, & Rafaeli, 2003; Reis, Gable, & Maniaci, 2014), but these questions were not examined in O'Connor and Rosenblood. Hofmann et al. (2012) appear to demonstrate (although do not directly report) that desire to socially interact increases over the course of the day and then decreases in the evening, which offers some evidence that desire to interact varies throughout a day. Finally, it is prudent to seek further evidence of the regulation of social interaction beyond the convenience sample of college students. As O'Connor and Rosenblood (1996) note, obligations of work and family life are constraints on the regulation of social interaction, and each is more common among employed adults than college students.

Methodological Concerns

Methodologically, there are several problems with the analyses techniques used in O'Connor and Rosenblood (1996). By design, ESM is intensive longitudinal sampling, which generates multiple observations nested within individual. When responses are nested within person, it violates the assumption of independence of observations (Kenny, Kashy, & Cook, 2006; Schoemann, Rhemtulla, & Little, 2014). By treating observations as independent (i.e.,

disaggregated observations from participants), the original analytical strategy risked making several statistical fallacies, including the ecological fallacy (Schoemann et al., 2014). Second, there was no control for, or estimation of, within-person effects of desire to interact on social interaction. That is, individual variation in desire to interact and social interaction frequency were not accounted for in the original study. Social interaction and desire to be alone vary both between subjects (i.e., level-2) and within subjects (i.e., level-1), and should be modeled appropriately (Bolger & Laurenceau, 2015). Furthermore, ESM violates the assumption of non-independence of observations (Bolger et al., 2003). Even in the case that intraclass correlations are very weak, a multilevel model better accounts for the non-independence of observations and within-person effects, than does using disaggregated data as did O'Connor and Rosenblood (Kenny et al., 2006; Schoemann et al., 2015). Furthermore, one of the advantages of ESM is the ability to make weak causal claims by treating individuals as their own statistical control (Bolger et al., 2003; Bolger & Laurenceau, 2015). Although the original study examined the possibility of causal effects of desire to interact on future interaction, it did not account for the confounding effects of time (Bolger & Laurenceau, 2015). This is problematic given that O'Connor and Rosenblood included observations from the prior night as predictors of behaviors the following morning.

The analysis strategy of the original study also influenced variable construction. To construct their transition frequency matrix and to measure social satiation, O'Connor and Rosenblood removed much of the variation in the predictor variable, desire to be alone, by collapsing responses on a 7-point scale into two or three categories. This removed valuable variation in the independent variable, as dichotomization is generally not a recommended strategy (MacCallum, Zhang, Preacher, & Rucker, 2002). This is particularly problematic in the

analysis of the moderating effect of desire to interaction (i.e., satiation) on future interaction. The satiation variable was composed of both predictor variables, and was created by dichotomizing the primary predictor variable. Yet, when testing the model, they did not statistically account for the two original main effects of the variables measuring satiation. Effectively, they confounded their moderating variable with their independent variable (i.e., contact/alone). An interaction term with the two main effect predictors would have been an appropriate test of their hypothesis.

METHOD

Sample

Undergraduate participants ($N = 54$) were recruited from at a large Midwestern university. Participants were offered research credit in an introductory course and a financial incentive in exchange for study completion. Participants were 50% female, and were an average of 19.1 years old ($SD = 1.23$, Range $= 18$ to 22). Participants described their race/ethnicity as primarily White (67%), but also 16% Asian, 9% African-American, 7% Latino, and 1% Native American.

Adult participants ($N = 62$) were recruited through a network sample of adults through two graduate research assistants. Inclusion criteria included that participants had to be over the age of 28 and have a mobile phone with short message service (SMS) (i.e., text messaging) capabilities. To be included in the study, working adult participants had to be able to respond to the SMS surveys at their jobs. Participants were offered a financial incentive for study completion. Adult participants were 64% female, and were an average of 38 years old ($SD = 11.24$, Range $= 28$ to 77). Participants primarily described their race/ethnicity as White (95%), with 3% African-American, and 2% Latino. Participants were highly educated. Less than 10% had completed a high school education or less, 32% had completed a BA, and 58% had

completed a professional graduate degree or MA/PhD. Approximately 45% had no children, and the remainder had between 1-4 children ($M = 1.13$, $SD = 1.16$). Most of the adult sample (80%) was engaged in full time employment, with 8% working part time, 7% retired, and 5% were full time parents. Current place of residence was not an exclusion or inclusion criteria. Participants resided in Texas (59%), Kansas (26%), Missouri (6.5.%), or four other states: Georgia, Colorado, New York, and Oregon.

Procedure

After being recruited, the study design and procedure was explained either in person or on the telephone, and then participants were orally consented. Subsequently, participants completed an online survey collecting demographic measures and other measures not reported here. One or two days after completing the online survey, participants began the ESM portion of the study by receiving surveys on their mobile phone, with responses given via text message. Participants were sent SMS surveys at five random intervals of time through their mobile device for five consecutive days. The times of the SMS surveys were created through stratified sampling: one SMS survey was sent at a randomly selected minute every 2.5 hours. The time between SMS surveys in the present investigation was twice as long as O'Connor and Rosenblood, so participants in the current study completed about half as many responses in any given day. However, the present investigation was also interested in between-day lag in social interaction processes. Participants in the current study participated for 1-2 more days than participants in the original study. The number of samples within-day (i.e., 5) and the number of consecutive days participating (i.e., 5) both exceeded recommended guidelines for examining within-person effects within a day and between days (Bolger et al., 2003; Stone & Shiffman, 2002). The present design increases the range of reported behaviors, which increases the generalizability of

within-person effects (Stone & Shiffman, 2002).

Measures

The SMS survey used two questions that were very similar to O'Connor & Rosenblood. The first question asked participants, "Have you had a social interaction with anyone in the last 10 minutes?" Social interaction was not defined for participants, and the 10 minute recall time frame is within acceptable guidelines (Stone & Shiffman, 2002). Participants in O'Connor and Rosenblood were allowed to respond in three ways: they were alone, were in social contact, or that they were alone, but other people were present. The last option was excluded from data analyses in the original study, so that option was not offered in the current study. The second question used the exact wording and scale of O'Connor and Rosenblood: "Would you like to be completely alone right now?" on a 7-pt scale (1 = No, 4 = Neutral, 7 = Yes).

Participants were asked not to respond to SMS surveys if they were driving or in class. If participants missed or did not see a SMS survey, they were asked to respond as soon as they were able. They were asked to report based upon the 10 minutes prior to responding, not to try to recall what they were doing or how they felt when they actually received the SMS survey. If they had received more than one SMS survey while they were unable to respond, they were instructed to respond to the most recent message and ignore the earlier message. Each response was time stamped at the time of completion. The final dataset consisted of 116 (participants) x 5 days x 5 experience samples = 2,747 (95% completion rate). Ninety-one percent of participants completed at least 22 of the possible 25 SMS surveys. Unlike O'Connor and Rosenblood, no responses were excluded or removed due to time delay between responses; rather time was modeled directly by time lapse since last completed SMS survey (Bolger & Laurenceau, 2015).

RESULTS

Descriptive Analyses

  The community sample was significantly more likely to be in contact, $M = 75\%$, than the student sample, $M = 66\%$, $t(114) = 2.53$, $p = .013$. The mean desire to be alone for participants in the community sample, $M = 3.33$, $SD = .91$, did not differ from the mean desire of the student sample, $M = 3.59$, $SD = .75$, $t(114) = 1.68$, $p = .092$. Age was not associated with having had a social interaction, $r(115) = .15$, $p = .108$, or with mean desire to be alone, $r(115) = -.17$, $p = .074$.

Figure 1: Percent in Contact & Desire to be in Contact by Hour of Day

Desire to be in Contact
In Contact
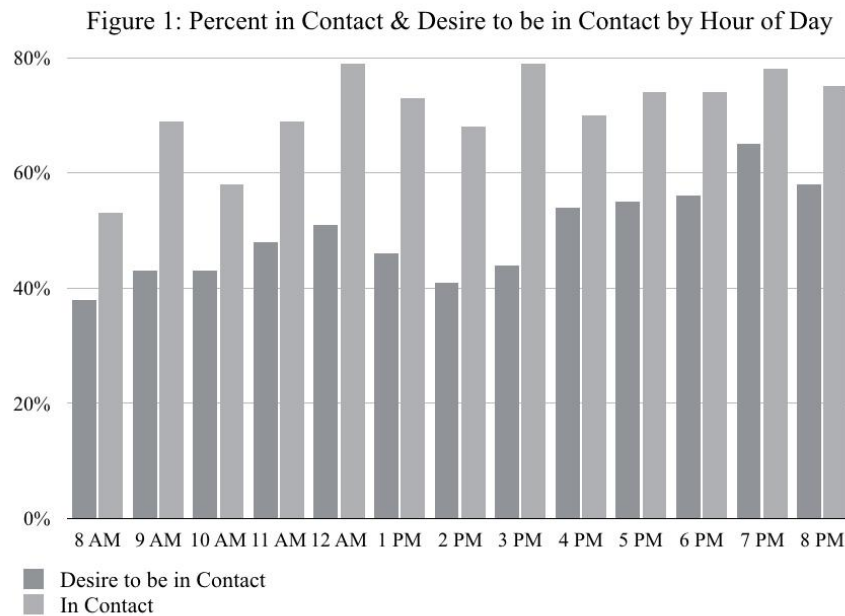
  Participants were in social contact 71% of the time and alone 29% of the time, as compared to 47% and 42% respectively reported by O'Connor and Rosenblood (the "with people, but not in contact" response excluded from the original study's statistics). Collapsing participants' responses to the "desire to be alone" question into trichotomous categories for direct comparison sake, participants in the current study reported they wished to be alone 24% of

the time, were neutral 30% of the time, and wished to be in contact 46% of the time, as compared

to 43%, 6%, and 51% respectively as reported by O'Connor and Rosenblood. Compared to

participants in O'Connor and Rosenblood, the present study's participants were more likely to be

in social contact than alone, and more likely to be neutral when reporting their desire to be alone.

O'Connor and Rosenblood report that 66% of participants' affiliative experiences were

optimal; that is, they were interacting and wanted not to be alone, or they were alone and wished

to be alone. In contrast, only 47% of participants in the present study were in an optimal state:

10% alone and wished to be alone, 37% in contact and wished to be in contact, and 53% were

not in an optimal state. Participants in the present study were much less likely to be in an optimal

affiliative state, likely due to a much higher frequency of a neutral response.

The present investigation sought to explore the nature of social interaction, desire to

interact, and social satiation throughout the day. Each of the responses to the EMS questions was

time stamped, which provided a record of the hour and minute of response for each participant.

Figure 1 reports the percent of participants in social contact throughout the day by hour. To

illustrate desire to be alone on the same figure for sake of comparison, the desire to be alone was

reverse scored and Z-transformed to report the mean desire to be in contact by percentile by hour

of the day. The present investigation also sought to examine the nature of social satiation. Figure

2 reports the percent of participants in optimal social states over the course of the day. As the day

progressed, participants transitioned toward more social satiation and less aloneness satiation.

Main Analyses

Given the methodological concerns (i.e., no control for within-person effects, collapsing

of the independent variable, etc.), an analytical replication of O'Connor and Rosenblood was not

conducted. Rather the data were analyzed using multilevel modeling (MLM) in Mplus 7.0

(Muthen & Muthen, 1998-2007) to model the within-person trajectories and between-person differences of homeostatic social interaction regulation. Bolger and Laurenceau (2015) recommend that the independent variable (i.e., desire to be alone) be both grand mean and person centered at level-2, and person centered desire to be alone used as a level-1 predictor. This creates an interpretable intercept and yields two independent variables representing desire to be alone: the between-subjects means and the within-subjects deviations (Bolger & Laurenceau, 2015). O'Connor and Rosenblood sought to document within-subject causal process of desire to interact on future social interaction, but was not able to do so statistically given that data were disaggregated from respondent. To model such causal processes using the individual as his or her own control, a lagged analysis is required, wherein both the dependent and independent variable at the prior time point are used to model the dependent variable at the following time (Bolger & Laurenceau, 2015). Including the person-centered dependent variable at the earlier time point (i.e., past social contact) is necessary to test the original study's hypotheses. The MLM constructed for the present investigation also included the grand mean centered number of minutes since last completed SMS survey to account for the effect of time lapse on the relationship between the primary variables (i.e., minutes lapsed). The MLM was estimated using the categorical option in Mplus because the dependent variable (i.e., social contact) was dichotomous by nature. Odds-ratios with confidence intervals were reported. A random-intercept-only model was estimated because random variation at the lower, within-subject level is not appropriate when the dependent variable is dichotomous (Bolger & Laurenceau, 2015). These techniques addressed the primary concerns with the original study's analyses.

Figure 2: Percent in Satiated State Over Day
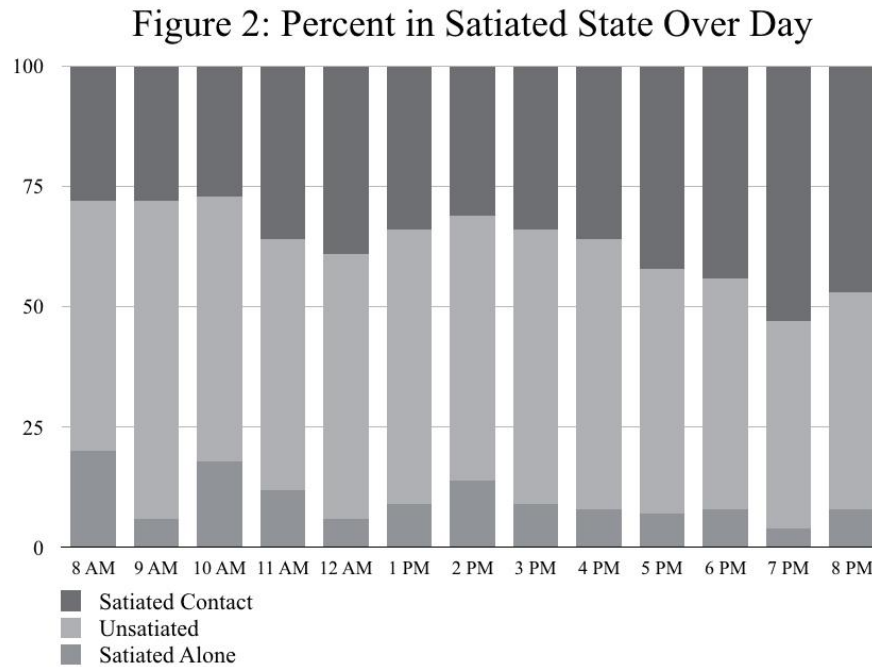
One additional concern with the original analyses was treated empirically. Specifically,

the present investigation tested the lagged effect of desire between days and the lagged effect of

desire within days. To do so, two MLMs were constructed. The first model only included the

prior night's desire to be alone and prior night's contact to predict contact the next morning ($n =$

459; Column 1). The second model used the prior time's desire and contact to predict future

contact within the day, excluding observations from the night before ($n = 2,110$, Column 2) (see

Table 1). These models were not nested, so testing differences in model fit could not be used to

determine which model was a better fit to the data. However, results indicate that the predictive

value of desire to interact on future interaction was not significant when the prior night's

information was estimated, but it was significant within the day. That is, only the within-day

lagged effect of desire was significant.

Table 1: *Parameter Estimates for the Multilevel Model of Future Social Contact: Past Social Contact & Desire to Be Alone Prior Night Only and Excluding Prior Night, & Time Moderation*

	Prior night only (N = 456)	Excluding prior night (N = 2,110)	Moderation by minutes lapsed (N = 2,110)
Fixed Effects	*B* (SE)	*B* (SE)	*B* (SE)
π_{0j} Intercept	-.261** (.148)	-1.165** (.095)	-1.166** (.092)
Past social contact	.562 (.290)	-.177 (.126)	-.177 (.126)
Odds-ratio	1.75 (.99-2.83)	.84 (.66-1.07)	.84 (.66-1.07)
Within-past desire to be alone	-.064 (.067)	-.105** (.032)	-.106** (.032)
Odds-ratio	1.06 (.93-3.09)	.90 (.85-.96)	.90 (.85-.96)
Between past desire to be alone	-.482* (.174)	-.385** (.110)	-.385** (.110)
Minutes lapsed from last SMS	.002* (.001)	.002* (.001)	.002* (.001)
Odds-ratio		1.002 (1.001-1.003)	1.002 (1.001-1.003)
Lapsed x Past Desire			.000 (.000)
Random effects			
Residual	1.062* (.413)	.610** (.132)	.610* (.132)
Goodness-of-fit			
AIC	606.00	2296.0	2297.9
BIC	626.61	2330.0	2337.4

Notes: $N_{participants}$ = 116, 5 days, 5x per day; *p* < .01 **p* < .001; Within-desire to be alone and social contact both person centered; Between-past desire to be alone is a between-subjects level-2 estimator that is grand mean and person centered; Minutes lapsed since last is the number of minutes since last SMS survey and is grand mean centered; Autocorrelation between errors are not estimated in Mplus 7.0. SMS = short message service
*p < .01; **p < .001

When experience samples from the night before were removed, the results largely support the findings of O'Connor and Rosenblood, who found that desire to be alone or desire to interact increased the likelihood of desired state in future interactions, and the prior state of interaction (i.e., social contact vs. alone) did not predict future interaction state. Given the greater time interval in the present study (~142 minutes) compared to the original work (~70 minutes), the results of the present investigation offer further support for O'Connor and Rosenblood's conclusion that prior interaction state is not associated with future interaction state. Column 3 on Table 1 reports the results of an additional moderation, which was conducted to determine whether the effect of desire to be alone was moderated by the number of minutes passed since

last experience sample. This examines whether the effect of desire is heightened or diminished as the number of minutes between experience samples increased. There was no support for this moderation. Taken together, the analyses reported on Table 1 provide additional support for the argument in the original study that the predictive value of desire for social interaction persists over the course of several hours.

Table 2: *Parameter Estimates for the Multilevel Model of Future Social Contact: Moderations by Satiation, Sample, & Age* ($N_{observations}$ = 2,110)

	Satiation Moderation	Sample Moderation	Age Moderation
Fixed effects			
π_{0j}intercept	-1.156** (.093)	-1.936** (.282)	-.640* (.237)
Past social contact	-.153 (.129)	-.186 (.126)	-.185 (.127)
Odds ratio	.86 (.67-1.11)	.83 (.65-1.06)	.83 (.64-1.07)
Within – past desire to be alone	-.105 (.032)	-.097 (.097)	-.092 (.080)
Odds ratio	.90 (.85-.96)	.91 (.75-1.10)	.91 (.78-1.12)
Between - past desire to be alone	-.385** (.110)	-.335** (.108)	-.319* (.113)
Minutes lapsed from last SMS	.002* (.001)	.002* (.001)	.002* (.001)
Odds ratio	1.002 (1.001-1.003)	1.002 (1.001-1.003)	1.002 (1.001-1.003)
Past Contact x Past Desire	-.054 (.072)		
Sample		.530* (.180)	
Sample x Past Desire		-.008 (.062)	
Age			.018* (.002)
Age x Past Desire			.000 (.002)
Random effects			
Residual	.614** (.113)	.545** (.122)	.581** (.119)
Goodness-of-fit			
AIC	2297.5	2191.7	2245.5
BIC	2327.1	2336.9	2290.5

Notes: N = 116, 5 days, 5x per day; **p < .01 ***p < .001; Sample: 1 = community, 0 = student; Both sample and age variables were between-subjects (level-2) predictors. Desire to be alone and social contact both person centered; Between-past desire to be alone is a between-subjects level-2 estimator that grand mean centered; Minutes lapsed since last is the number of minutes since last SMS survey and is grand mean centered; Autocorrelation between errors are not estimated in Mplus 7.0.

Moderation Analyses

Three other analyses (Table 2) were conducted to further extend and replicate the findings of O'Connor and Rosenblood (1995). The authors suggested that individuals are less likely to be engaged in the same state of interaction if they did not wish to be in that state in the prior point of time (i.e., moderation effect of desire to be alone by social contact). This possibility was modeled by creating an interaction effect of contact by desire (i.e., Column 1), but this term was not significant and model fit was worsened through the inclusion of the interaction term. Furthermore, two moderation analyses were explored to determine if the sample characteristics (i.e., undergraduate vs. adult; age of participant) moderated the effect of desire to be alone on future interaction. The second and third columns in Table 2 showed that no such effects were not supported by the data, but the adult sample engaged in more social interaction than did the student sample.

Table 3. *Parameter Estimates for the Multilevel Model of Future Social Contact as a Function of Past Desire and Contact and Prior Day Mean Desire ($N_{observations} = 1,707$)*

	Parameter	Model 5
Fixed Effects		
π_{0j}Intercept	γ_{00}	-.893*** (.261)
Wave	γ_{01}	-.016 (.011)
Past social contact	γ_{02}	-.245* (.139)
Within-past desire to be alone	γ_{03}	-.115*** (.036)
Between-past desire to be alone	γ_{04}	-.529*** (.141)
Mean desire previous day	σ_0^2	.083 (.071)
Random effects		
Residual	σ_ϵ^2 .	.775*** (.169)
Goodness-of-fit		
AIC		1879.80
BIC		1919.9

Notes: $N = 116$, 5 days, 5x per day; *$p < .01$ **$p < .001$; Desire to be alone and social contact both person centered; Between-past desire to be alone is a between-subjects level-2 estimator that grand mean centered; Mean desire previous day is a level-2 predictor. Minutes lapsed since last is the number of minutes since last SMS survey and is grand mean centered; Autocorrelation between errors are not estimated in Mplus 7.0.

Within versus Between-Day Influence

One additional MLM (Table 3) explored the possibility the prior day's total desire to be alone would predict the following day's interaction. To do so, a three level model was constructed: level-3 person, level-2 day, and level-1 interactions. A single level-2 variable was created to test this between-days lagged effect: mean desire to be alone in prior day. Results indicate that the prior day's mean desire to be alone was not associated with the following day's social interaction. Rather, the prior time's desire to be alone within the day was the best predictor of future social contact, even accounting for the prior day's mean desire for contact.

DISCUSSION

The present study extended and replicated O'Connor and Rosenblood's (1996) classic study on the homeostatic regulation of social interaction. Using updated statistical methods to control for within-person effects and the non-independence of observations, the findings of the present investigation supported the primary claims of the original study. Namely, that within any given day, if a person desires to be alone at one time they are more likely to be alone later in the day and if a person desires social contact they are more likely to be in contact later in the day. The effect of social desire lasts for at least several hours. Results also support the original claim that state of interaction at any given time point is not a good indicator of future contact; that is, people do not merely continue on in prior states of interaction. The present investigation demonstrated that these effects are similar for college undergraduates and middle-aged and older-adults. Furthermore, although mean levels of social contact and desire to be alone differed between the present investigation and O'Connor and Rosenblood, as did the statistical models used to examine those effects, the relationships between the primarily variables of interest were

quite consistent between studies. The present investigation offers new insights into the time frame of social interaction regulation, and demonstrates the applicability of the SAM to young adult and older adult populations alike.

Extending SAM

The present investigation extended the SAM approach by offering further information about social contact regulation within the day. Descriptive results (Figure 1) demonstrate that both the frequency of social contact and the desire to be in social contact rose throughout the day, reaching peak levels near the mid-afternoon and afterward tapering off into the evening. The daily pattern of the frequency of social contact is also evidenced in the time elapsed variable in the MLMs, which indicated that at later times in the day individuals were more likely to be in social contact. This pattern is also seen in the descriptive presentation of satiation effects (Figure 2): as the day progresses, individuals become more likely to be in social satiation (i.e., be in contact and desire contact) and less likely to be in satiated aloneness. This suggests that social interaction might have a diurnal rhythm, similar to other emotional and bodily processes. Both of these findings could be modeled in future research using a growth curve model (Schoemann et al., 2015), wherein individual differences in affiliation motivation or other characteristics (e.g., sex, type of employment, relationship status) could predict both the mean levels and rates of change of social interaction and desire to interact over the course of the day.

The SAM approach was also advanced by exploring the effect of prior day desire to be in contact on the subsequent day's social interaction behavior. Results suggest that social contact appears to be regulated within days, rather than between days. Accounting for the prior day's mean desire to be in contact, within day cross-lagged desire to be alone still predicted interaction likelihood the next time period. Furthermore, the present investigation offered evidence that the

responses to SMS survey the prior night is not predictive of state of social contact the following morning. When within-day effects were estimated, desire to be alone at an earlier time point was predictive of future state of contact. Both findings suggest that social interaction is regulated within a day, rather than across days.

The present investigation provided evidence pertaining to the important task of establishing the appropriate frequency of measurement for homeostatic processes (Deboeck, 2013). Specifically, the moderation between the amount of time lapsed between experience samples and the effect of past desire to interact on future contact was tested. Yet, this moderation was not supported. It is important to point out that these results are consistent with the original study's conclusion that the influence of the desire to interact carries over for between one and four hours of time. Although further interpretation of null findings is presumptive at best, it can point to a direction for future research. Consistent with SAM and more recent considerations of regulatory processes (e.g., Hofmann et al., 2012), time should intensify the motivation to socially interact, but only in the case that individuals have not socially interacted since the last experience sample. This question might be resolved with an additional measure of how much social interaction took place *between* experience samples. Future work should establish whether cumulative social activity between each experience sample could help explain the lasting influence of desire for contact on future contact state.

Satiation and homeostasis

SAM proposes a theoretical mechanism that models departures from a social equilibrium state. This model suggests that the larger the departure beyond the point of comfort, the greater the forces pushing back toward equilibrium. This concept is a core component of SAM, as elaborated by O'Connor and Rosenblood (1996): "Theoretically, individuals are motivated to

continue in an elected social circumstance only until they have re-established their optimal range.

At this point, if individuals remain in that social circumstance, they will eventually acquire an

excessive amount of it, and this will cause them to deviate from their optimal range. Once this

occurs, individuals will then be in a nondesired social circumstance and will be motivated toward

the opposite social circumstance" (p. 520). However, the present investigation was unable to

replicate this particular finding of O'Connor and Rosenblood. That is, the present investigation

did not support this proposed interaction effect resulting from satiation. Even if the SAM

approach to social satiation is theoretically defensible, there are several reasons that the present

investigation may have failed to replicate an effects.

Although this investigation provided some evidence that social interactions are regulated

within the day, one of the critical problems of documenting homeostatic effects is "there is little

to no literature about change on a time scale as fine as daily measurement" (Deboeck, 2013, p.

456). That is, the present investigation may have not had enough experience samples within the

day to model change over time. Secondly, if a homeostatic effect were present, such a model

may require the use of differential equation parameters within individuals, including slope,

intercept, and rates of change over time, especially if the effects are non-linear (Deboeck, 2013).

However, more continuous monitoring of social contact must be balanced with a concern for

participant burden and the reporting biases arising from too frequent sampling (Bolger et al.,

2003). Given these challenges, the present investigation offers three contributions toward

establishing an appropriate time scale for exploring regulatory processes: further exploration of

the cycle or shape of interaction and desire over a day (see Figure 1 and 2), confirmation of the

duration of the effect of desire on future interaction, and evidence of within- rather than between-

day effects.

One final issue for documenting satiation is identifying the appropriate measure of thresholds, satiation, and forces/motivations to establish equilibrium. O'Connor and Rosenblood (1996) suggest that individuals likely have different thresholds for managing their optimal social states, wherein some people can manage more non-optimal social interaction/time alone compared to others. Establishing a range of tolerance for non-optimal social contact requires the measurement of a variable beyond contact and desire to be alone, which is how the concept was operationalized in the original study and in the present investigation. In SAM, tolerance means acceptance of or endurance of a non-desired social state. Therefore, simply knowing that a person's social state does not match their desires is not a good indicator of tolerance (i.e., just because they do not desire it, does not mean they cannot tolerate it). Satiation is another difficult concept to measure because it does not mean that a social state matches a desired state. Rather, SAM suggests that the cumulative social experience meets one's needed level of contact within the day (or within some other yet-to-be-determined time scale for satiation). This requires measurement of both the social needs of the individual, and the degree of interaction that meet, do not meet, or exceed those needs. These concepts must be theoretically and operationally developed to further the study of social interaction regulation.

Limitations and Future Directions

It is important to point out that the present investigation was not a strict replication of O'Connor and Rosenblood (1996), partly because of needed statistical updates, and partly because the experience samples occurred at longer time increments and used slightly modified wording to measure social interaction. Additionally, there was a dramatic difference in the number of observations in this study with neutral responses on desire to interact (30%) compared to the original study (6%). Although it is unclear why this change might have occurred, it is

possible that the presentation of the item (i.e., electronic ESM methods versus paper and pencil) influenced these differences. Although the present investigation included non-student adult participants, the community sample was more educated and more likely to be White than members of the general public and came from Southern and Midwestern states. This, and the fact that both the original and present study used university students, calls into question the generalizability of these results to a broader population of adults.

Although the present results replicate the finding that desire to socialize predicts future interaction state, the results do not offer a clear explanatory mechanism for this effect. A recently proposed theory of social interaction, the Communicate Bond Belong (CBB) Theory (Hall & Davis, in press), suggests four factors regulating the choice to socially engage: the intensity of belongingness needs, the content of social interaction, extrinsic factors that constrain ability to interact, and the principles of energy conservation and investment. Drawing from recent extensions of the need to belong (e.g., Leary & Kelly, 2008), CBB Theory contends that belongingness needs are manifested in the desire to socialize (see also Hofmann et al., 2012). The theory posits that some social interactions are more capable of fulfilling needs than others, akin to O'Connor and Rosenblood's concept of social calories. Communication research has long suggested that everyday talk should be understood a relationally consequential action (Duck, 1991). Prior research suggests the content of social interactions influences the fulfillment of personal needs (Reis et al., 2000). If the need to belong is ultimately met in making and maintaining meaningful personal relationships (Leary & Kelly, 2008), then both the content of the social interaction as well as the partner with whom someone interacted should influence the satiation of the need to belong resulting from that interaction. In the CBB framework, the satiation of the need is made evident by the change in the desire (from before the interaction) and

by willingness (or lack thereof) to expend greater effort toward meeting the need. Additionally, as the SAM model and CBB Theory both contend, extrinsic and/or uncontrollable obligations and impediments conflict with the desired amount of social contact, presenting obstacles to regulating social interaction in a manner directly reflecting social needs. For example, workplace obligations may create impediments to achieving an optimal level of social contact; jobs may require individuals to have more or less social contact that they would otherwise desire.

CBB Theory (Hall & Davis, in press) further proposes that individuals should operate within the principle of energy conservation, wherein they will expend the least amount of energy necessary to satiate the need. Individuals should choose the most high yield, low effort interactions available. According to CBB Theory, when all of an individual's social energy is expended, he or she will seek to limit further interaction. That is, individuals do not have a limitless capacity to socially interact. Taken together, CBB Theory would predict that the desire to interact should occur when individuals experience acute belongingness needs, which should then motivate individual to seek social connection, accounting for the situational and relational constraints. Then, this choice of interaction partner and type of interaction should influence the satiation of needs. A few effortful social interactions could be as impactful on both need satiation and desire to interact further as several low effort interactions. When desire to interact decreases after the interaction, it would be evidence that individual's needs were met during the interaction. If the content of the interaction resulted in individuals feeling particularly connected and related, CBB Theory would suggest that individual's belongingness needs should be met for a longer period of time. A more complete model of social interaction, like CBB, could help extend O'Connor and Rosenblood's original work and SAM into a more complete account of social ecology management.

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