Securing your relationship: Quality of intimate relationships during the COVID-19 pandemic can be predicted by attachment style

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Abstract

The COVID-19 pandemic along with the restrictions that were introduced within Europe starting spring 2020 allows for the identification of predictors for relationship quality during unstable and stressful times.

The present study began as strict measures were enforced in response to the rising spread of the COVID-19 within Austria, Poland, Spain and Czech Republic. Here, we investigated quality of romantic relationships among 313 participants as movement restrictions were implemented and subsequently phased out cross-nationally. Participants completed self-report questionnaires over a period of seven weeks, where we predicted relationship quality and change in relationship quality using machine learning models that include a variety of potential predictors related to psychological, demographic and environmental variables.

On average, our machine learning tools predicted 29% (linear models) and 22% (non-linear models) of the variance with regard to relationship quality. Here, the most important predictors consisted of attachment style (anxious attachment being more influential than avoidance), age, and number of conflicts within the relationship. Interestingly, environmental factors such as the local severity of the pandemic did not exert a measurable influence with respect to predicting relationship quality. As opposed to overall relationship quality, the *change* in relationship quality during lockdown restrictions could not be predicted accurately by our machine learning models when utilizing our selected features.

In conclusion, we demonstrate cross-culturally that attachment security is a major predictor of relationship quality during COVID-19 lockdown restrictions, whereas sexual behavior, fear, pathogenic threat and the severity of governmental regulations did not significantly influence the accuracy of prediction.

1.1. Viral threat and political measures

In the spring of 2020, the world-wide spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to stressful and insecure conditions across many nations – which corresponded with severe health, economic, and social disruptions (UN, 2020; WHO, 2020). In Europe, the actual spread and effects of the virus, as well as national defensive measures taken to counteract the virus, differed between countries. For example, Spain had one of the highest infection and mortality rates in Europe, leading to limited access of medical care and the modification of public facilities to be used as field hospitals and morgues. Consequently, a nationwide state of alarm was issued, and the free movement of citizens was drastically restricted (Ministerio de la Presidencia, 2020). Despite lower case counts, Austria responded with curfew restrictions to limit the spread of the virus (BSGPK, 2020), where even countries with very low case numbers such as Czech Republic and Poland adopted strict defensive measures such as prohibiting gatherings and introducing minimal distance measures (Dziennik Ustaw, 491-522, 2020; MHCR, 2020). Varying viral impacts and medical capacities notwithstanding, all of these countries eventually introduced strict regulations, and all of them encouraged or reinforced ‘social distancing’ by prohibition of gatherings or movement restrictions.

1.2. The crisis and intimate relationships

Previous research has shown that stress impacts both relationship quality (i.e. how ‘good’ people subjectively perceive their relationship to be) (cf. Randall & Bodenmann, 2009, 2017), and the way intimate partners conjointly deal with stress (Falconier et al., 2015). Relationship quality in turn is closely linked to many parameters of well-being, including psychological and bodily health (Pieh et al., 2020; South & Krueger, 2013). Independent of the elicited stress, social isolation that removes other contacts facilitates an exclusively dyadic relationship for couples living together, and the rise in domestic violence since the implementation of movement restrictions suggest that this is not healthy for all romantic relationships (Bradbury-Jones & Isham, 2020).

Importantly, attachment style may be an influential factor that might determine how such restrictions and stressors influence relationship quality. Attachment theory has originally been proposed as an ethological framework that explains children’s reactions to stressful situations (Ainsworth & Bowlby, 1991). Individual developmental trajectories of attachment remain highly influential in adulthood, becoming activated upon stress exposure (Gillath et al., 2006) and influencing behaviors within intimate relationships as adults (Mikulincer et al., 2002). Similar to relationship satisfaction, secure attachment is significantly correlated with greater health and well-being (McWilliams & Bailey, 2010), where securely attached adults, whether in a relationship or not, may have overall more psychological resources to cope with distress. A variety of studies have found that securely attached individuals as opposed to those with non-secure attachment styles are affected more by distress (Zakin et al., 2003), and in turn are more prone to distort their representations of themselves and their social environment (Mikulincer et al., 1998). Furthermore, attachment security is crucial for maintaining satisfactory intimate relationships, and a number of studies have shown connections between attachment security and relationship outcomes, although determining causality poses a problem (see Mikulincer et al., 2002 for a review). Several mediators may account for such effects – for example, securely attached persons are known to engage in more mutual forms of conflict resolution than anxious or avoidant types (Corcoran & Mallinckrodt, 2000), and conflict style in turn has a major influence on relationship satisfaction (Cann et al., 2008).

Feeney (2002) notes that as opposed to securely attached persons, insecurely attached individuals’ evaluation of their own relationship is more strongly influenced by their

partners' recent behavior. Therefore, when predicting reported relationship quality, taking recent events into account (e.g., amount of fights) in addition to attachment style to the partner, may aid in the prediction of models aiming to capture such interactions. Moreover, the same events could be appraised differently by securely and insecurely attached individuals (Collins, 1996), making it essential to consider both actual events relevant to relationships and inner working models (i.e. the attachment to the partner). Thus, depending on inner resources to deal with external stress and inner representations of social relations, the COVID-19 crisis could turn out to be stabilizing for some relationships, and destabilizing for others.

Stressful periods such as the 2003 SARS outbreak are known to have significant impacts on intimate relationships that last far longer than the actual threat, evidenced in higher stress levels and increased divorce rates (Census and Statistics Department, 2007; Lee et al., 2007). One of the social behavioral systems affected severely by stress is sexual behavior (Bodenmann et al., 2006), an important and often defining feature of intimate relationships (Hazan & Shaver, 1987). Critically, however, the role of sexuality in stable relationships and its impact on psychological aspects such as well-being and relationships is still omitted in many studies (cf. Heiman et al., 2011). Notably, sexual behavior has indirectly been shown to be affected by external crises, where around nine months after severe threats, birth rates reliably go down throughout cultures, whereas milder threats such as low-severity storm advisories lead to increased birth rates (Evans et al., 2010; Chandra et al., 2018; Richmond & Roehner, 2018a,b).

Recent studies have linked attachment systems to sexual behaviors (e.g. Butzer & Campbell, 2008; Davis et al., 2006), where interestingly, sexual satisfaction might even mediate the effects of attachment anxiety on relationship satisfaction in women (Birnbaum, 2007). Moreover, securely attached persons tend to have less promiscuous and casual sex (Bogaert & Sadava, 2002). It has furthermore been suggested that low levels of environmental pathogens coincide with more liberal sexual behavior including promiscuity and casual sex and may even account for the evolution of cross-cultural differences in sexual norms (Thornhill et al., 2009; Tybur et al., 2015). Both of these aspects make sexual behavior a particularly interesting facet of human functioning during a world-wide medical crisis, and an indispensable factor to consider when observing intimate relationships.

1.3. Predicting relationship quality using machine-learning

The present study investigates a period during the spring of 2020, during which strict movement restrictions in response the COVID-19 pandemic were implemented and subsequently relaxed in Austria, Poland, Spain and Czech Republic. Over a period of seven weeks, participants from these countries completed self-report questionnaires regarding their romantic relationships, partner attachment, and sexual behavior, as well as questions related to the pandemic and its perceived threat. Our goal was to determine which variables predict i) relationship quality during this crisis, and ii) any observed changes in relationship quality. We hypothesize that attachment security and sexual behavior will be important predictors of both overall relationship quality and maintaining relationship quality during these unstable times. Additionally, perceived fear of the virus, the actual pathogenic threat (local spread of infections and mortality), and the severity of the lockdown measures may further influence relationship quality. We employ two types of robust, cross-validated machine-learning models: the LASSO (least absolute shrinkage and selection operator, Tibshirani, 1996), and Extremely Randomized Trees (ET, Geurts et al., 2006). These models incorporate and control for a large number of input factors while avoiding overfitting. Extremely randomized trees are in addition non-parametric and can detect complex non-linear interactions between the variables beyond conventional correlations.

2. Methods

2.1. Participants

Our sample consisted of 313 adult participants (mean age= 32.02 years, SD age= 12.99; 236 female; 267 heterosexual) who reported to be in a romantic relationship (mean duration = 7.18 years, SD= 8.58 years) and who repeatedly participated over a period of seven weeks. Participants resided in four main countries, which differed markedly in both prevalence of the virus and implemented measures: Austria (n= 104), Poland (n= 87), Spain (n= 65), Czech Republic (n= 33), and four additional regions (Germany, Netherlands, Italy, Pakistan; n= 24). No exclusion criteria were applied, but all cases with missing variables of interest were excluded for the machine learning models (see *Results* for trails included in each model).

2.2. Procedure

Weekly surveys (administered via SoSci Survey, www.soscisurvey.com) were sent via e-mail to participants who had been recruited over social media. Participants were informed about the aim of study and that they could stop participating at any point; they were fully debriefed and received the option to leave a contact address in order to be informed of the results of the study. All communication with the participants took place in their native language.

2.3. Timeframe and sociopolitical climate

The study period coincided with the implementation and loosening of governmental measures including curfews in the participating countries. The first survey was completed by participants between March 16th and 22nd (coinciding with the first curfews in Austria, a nationwide state of alarm in Spain and Czech Republic and a state of epidemic danger in Poland). The last survey was completed between April 27th and May 3rd, 2020, when the most drastic restrictions had been lifted in all countries.

2.4. Surveys

To measure attachment security, we administered the Experiences in Close Relationships Revised scale (ECR-R, Fraley et al, 2000) at the beginning and at the end of the study, which allowed us to estimate the temporal stability of this input feature. If available, validated translations of the questionnaire were used, otherwise the questionnaire was translated by a native speaker and reviewed by another native speaker (Polish version: Lubiewska et al, 2016; Czech version: Cígler et al, 2019; Spanish version modified from: Fernández-Fuertes et al, 2011).

Additionally, we assessed information regarding participants' romantic relationship. Here, we surveyed one general question directly targeting perceived relationship quality and one question each for 'tolerance for each other', 'joint activities with the partner', 'discussing important topics with the partner' and 'taking time for each other' are asked on a 5-point Likert scale. Additionally, one question on the amount of conflicts and several questions on sexual behavior and touching interactions are asked.

Moreover, we asked about perceived threat of the virus, perceived health and sportive activity. Demographic and personal items were collected, such as sex, sexual orientation, relationship status, and country of residence. Categorical features were one-hot encoded. We also used a 'stringency index' for each country and week as described by Petherick et al. (2020), denoting the gravity of governmental restrictions in response to the pandemic, as well utilized confirmed cases and deaths per million citizens (Sources: Eurostat 2020; Hale et al., 2020) for each week and country as a measure of viral spread and mortality.

In summary, Table 1 lists all input features included in our machine learning models.

2.5. Analysis

We fit two types of machine learning models, each trying to predict reported relationship quality and change in relationship quality, respectively. One linear (LASSO [least absolute shrinkage and selection operator], Tibshirani, 1996), one non-linear (ET [Extremely Randomized Trees], Geurts et al., 2006). The models were evaluated with nested cross-validation (90/10, 100 repeats each), where hyper-parameter tuning took place in the inner loop and only used training data from the current loop (Cawley & Talbot, 2010). Cross-validation was stratified, controlling for participant ID to counteract subject cluster learning. We compared the models' performance in the respective hold-out sets to a *trivial predictor*, which uses the mean of all target variables for each prediction.

Notably, the variance of the testing set explained by predictions trained on the training set will be smaller than when a conventional model is being fit to all of the data, however, the results are models capable of actual predictions for unknown data. Furthermore, our models are particularly suited to handle many input features while all the same avoiding overfitting. Extremely randomized trees in particular are non-parametric (the LASSO, in contradiction, imposes a linear structure) and handle complex interactions between the variables, beyond what regression analysis could encompass. To estimate the predictive value of the input features, we report the median permutation feature importance for the better-performing model as the proportional loss of explained variance if the input is replaced by a random (non-informative) array of that variable (Breiman, 2001). Further, we also show model-based feature importance (the coefficients assigned to input features by the models normalized each by the sum of all coefficients). Analyses were conducted in Python 3.7.7. (Scikit-learn 0.22.2., Pedregosa et al., 2011) and R (R Core Team, 2017).

3. Results

3.1. Relationship quality throughout the crisis

Overall, relationship quality remained fairly constant throughout the curfews, as the majority of all participants did not report any changes. However, exactly one third of all participants did report changes in their relationship quality. We aim at predicting these inter-individual differences regarding the stability of relationship quality below.

3.2. Predicting overall relationship quality

On average, around 30 percent of the variance in ratings on relationship quality during the lockdown was predicted by the linear models (LASSO), whereas the non-linear models (ET) on average predicted 22 percent of this variance. (LASSO: $R^2_{\text{avg}}=0.29$, $R^2_{\text{median}}=0.33$, $p<0.001$; ET: $R^2_{\text{avg}}=0.22$, $R^2_{\text{median}}=0.23$, $p<0.001$; $N_{\text{trials}}=731$).

Based on permutation feature importance (PFI), the most important input features with an importance over 5% for the linear model were *age* (13.92%, younger age predicting higher quality), *conflicts* (12.88%, less fights predicting higher quality) and *attachment anxiety* (8.62%, less anxiety/avoidance scores predicting higher quality) (Fig. 1A); whereas for the non-linear model, *conflicts* (6.32%), *joint activities* (5.68%), *time investment* (7.24%) and *attachment anxiety* (5.60%) were contributing most.

The most important features remain the same when assessing model-based feature importance, although in a different order: *Conflicts* (0.13), *attachment anxiety* (0.12), *age* (0.11), *joint activity* (0.09), *time investment* (0.07) and *avoidant attachment* (0.07) for the linear models (Fig. 1B); *joint activity* (0.25), *conflicts* (0.14), *attachment anxiety* (0.13), *avoidant attachment* (0.09), *time investment* (0.09) and *tolerance* (0.06) for the non-linear models. For the slightly better performing linear models, Figure 1 shows the permutation feature importance and model-based importance of all features.

The above models consider attachment security and avoidant attachment as two separate input features. To assess the importance of attachment relative to other variables, we then combined both subscales of the ECR-R and used it as a single feature. Here, the ECR-R score indicating overall attachment security is by far the most important feature (responsible for 19.11% and 11.03% of the explained variance in the linear and non-linear model, respectively).

Figure 1C shows how this most informative predictor (the sum of anxiety and avoidance) is linked to relationship quality in our non-linear models. It indicates that a non-linear use of this measure is most beneficial when predicting relationship quality.

3.3. Changes in relationship quality cannot be predicted

As opposed to the overall quality, *changes* in relationship quality could not be predicted by our models better than by a trivial predictor (LASSO: $R^2_{\text{avg}}=-0.14$, $R^2_{\text{median}}=-0.06$, $p=1$; ET: $R^2_{\text{avg}}=-0.31$, $R^2_{\text{median}}=-0.14$, $p=1$; $N_{\text{trials}}=708$). The only feature with a model-based feature importance above zero in both model types was the participants' answer to the item 'my partner takes time for me' (*model-based feature importance*: LASSO = 0.58; ET = 0.24; $\text{PFI}_{\text{both}}=0$). A *post-hoc* analysis revealed a Pearson correlation of $R=0.21$ ($\text{BF}_{01}=0.695$) between this time-investment and the change in relationship satisfaction over time.

Figure 1. *Permutation feature importance (A) and model-based feature importance (B) over linear models with relationship quality as a target. C) Use of attachment security (overall score) as a predictor by the non-linear models.*

3.4. Temporal stability of attachment security

An important predictor for relationship quality was attachment security as measured by the ECR-R, and we performed a *post-hoc* group comparison with all participants that had filled in the questionnaire both times (around four weeks apart). There was no difference in attachment security between the beginning and end phase of the lockdown (mean decrease by 0.05%, $BF_{01}=14.924$; shared variance = 76.91%; $N=140$). This is in line with the good 3-week test-retest reliability reported for the ECR-R (84-85% shared variance, Sibley et al., 2005).

4. Discussion

The aim of the current present study was to predict relationship quality as movement restrictions in response to the COVID-19 pandemic are implemented and loosened in four European states. Using attachment as one of the most important predictors, our linear models predicted around 30% of the variance in self-reported relationship quality. This is in line with studies finding that ECR-R scores explain a large amount of between-person variation of emotional experiences with the partner (Sibley et al., 2005).

4.1. Predictors of relationship quality

Nationwide movement restrictions constitute special circumstances for people in romantic relationships; due to curfews, couples become each other's only social contact. Indeed, in such unstable times, people may have to endure increased stress levels in response to the medical threat and subsequent societal changes, which might further influence relationship dynamics. In line with our hypotheses, attachment security was a major predictor of relationship satisfaction during the time of curfews and social restrictions. This corroborates previous studies that have linked attachment styles to relationship quality (e.g. Mikulincer et al., 2002) and this effect may even be increased by the stressful effects of the crisis by activating those patterns (cf. Gillath et al., 2006). Mikulincer and colleagues (2002) propose three main avenues by which relationship quality may be influenced by attachment style: secure attachment may orient individuals towards a positive bias of dyadic interactions, positive representations of the self and others which affect conflict management, as well as the satisfaction of other psychological needs (Mikulincer et al., 2002). Interestingly, in the current study, the dimension 'anxiety' was a more important predictor than the subscale 'avoidance'. Potentially, this difference is enhanced by a general decrease of external security in times of crises. Secure attachment may further relate to an internal locus of control (Hexel, 2003), and securely attached individuals may have more mechanisms to cope with the stress a world-wide crisis elicits (Feeney, 1995). Indeed, an analysis of subjective health in our sample over time shows that attachment security is a predictor of a heightened sense of health (Eder et al., 2020, August 22). This means that the effects of secure attachment are not refined to the relationship per se, but may exert an influence over various psychological mechanisms.

Importantly, the accuracy of predictions for relationship quality could have been enhanced by taking both partners into account. Senchak and Leonard (1992) report that the pairing of attachment styles rather than individual attachment is associated with marital satisfaction. Specifically, as opposed to couples where both partners are securely attached ('secure couples'), couples where a securely attached person is in a relationship with an insecurely attached person do not differ from 'insecure couples'. However, securely attached persons tend to pair with securely attached partners (Senchak & Leonard, 1992), potentially buffering this confounding factor.

Attachment has traditionally been classified into attachment styles (Ainsworth & Bowlby, 1991; Feeney & Noller, 1990), although many have argued that attachment security should be treated as a continuum (Fraley et al., 2015; Lubiewska & Van de Vijver, 2020; Haslam et al., 2020). Indeed, the way our non-linear models use the ECR-R score to optimize the predictions of relationship quality (Fig. 1C) suggests that a non-continuous use of the variable (divided to the categories secure/less secure) may be justified as a simplified measure when investigating implications for adult relationship satisfaction.

Unexpectedly, the age of participants had a very high feature importance, where younger participants self-reported higher quality scores with respect to their relationships. Some longitudinal evidence may support this conclusion, such as an increase in unpleasant aspects in the relationship over time (Birditt et al., 2009); and weak correlations between younger age and higher relationship satisfaction have been reported previously (Lenger et al.,

2008). However, both longitudinal and cross-sectional studies would be of high value to follow up on this little investigated aspect of relationships.

In both linear and non-linear models, another important predictor of how participants rated their relationship quality was the number of arguments with the partner they reported per week, where frequency of conflicts has previously been shown to cause lowered relationship quality (Kluwer & Johnson, 2007). Our results confirm the predictive value of amount of conflicts, and suggest that simplified behavioral observations or surveys on relationship quality need to include this aspect. Thus, our findings emphasize the dimension ‘agreement’ over other dimensions of intimate relationships, such as intimacy and independence, but also sexuality (cf. Hassebrauk & Fehr, 2002). This is surprising, since engaging in sexual behavior is an important aspect of pair-bonding that has repeatedly been demonstrated (Birnbbaum & Finkel, 2015; McNulty, Wenner, & Fisher, 2016). Moreover, despite the fact that sexual satisfaction cannot predict changes in relationship quality or vice versa in some studies (Byers, 2005; Joel et al., 2020), as is in line with our results, it does seem to relate to relationship quality at a given point in time (Byers, 2005; Joel et al., 2020), and in some studies even to future relationship quality (Fallis et al., 2016). However, the actual number of sexual intercourse alone is no telling measure of relationship satisfaction (Loewenstein et al., 2015), and a curvilinear relationship between sexual frequency and overall happiness has been proposed (Muise, Schimmak, & Impett, 2015), which, if applicable to relationship satisfaction, should nevertheless have been detected by our non-linear models. ‘Sexual afterglow’ – evidenced in elevated levels of sexual satisfaction – might facilitate pair bonding beyond sex (Meltzer et al., 2017); however, the effect could have been captured by our input feature ‘sexual satisfaction’. Overall, no aspect of sexual behavior or satisfaction was predictive for reported relationship quality in our models, and our data do not provide further evidence to the large body of literature connecting the variables. A deeper understanding of circumstances and motives (‘sexual goals’) of sexual behavior in romantic relationships may help to clarify this relationship (cf. Muise, Boudreau, & Rosen, 2017).

Previous studies have found that changes in relationship quality are harder to predict than relationship quality at a given point in time (Joel et al., 2020). Our results show that this is the case even in a period where many quantifiable environmental factors act on intimate relationships, since our models completely fail to predict changes in relationship quality. The fact that we did not observe changes for most participants may in part account for this difficulty. None of the environmental features or the features that do predict general relationship quality in the sample seem to add information about changes in quality. An exception to that is the perceived time investment by the partner, which had a non-zero model-based feature importance and was *post-hoc* shown to correlate with changes in relationship quality. While this study can not conclusively support the role of time investment for temporal changes in relationship quality, this may provide an interesting starting point for further studies.

4.2. Generalizability

The cross-cultural composition of our sample and the fact that our models are evaluated by their performance on unknown subjects promises a relatively high generalizability for western cultures, however, our results may not hold true for older populations. Furthermore, we did not exclude or control for clinical psychological conditions, which might have distorted the results obtained in these globally stressful times. Cross-cultural studies on similar situations are needed to further investigate the role of attachment style in crisis-like situations, and studies taking into account both partners in a romantic relationship could further benefit such predictions (dyadic data, see Kenny et al., 2006).

4.3. Conclusion

The current study provides evidence on the complex interactions between relationship quality, attachment style, and demographic variables in couples during exceptional and stressful circumstances. We examined and predicted relationship quality as lockdown measures due to the COVID-19 pandemic are implemented in four European states. We found that attachment security was a highly important predictor for relationship quality, and that country of residence, case counts, and the stringency of governmental measures did not contribute to accurate predictions. Changes in relationship quality could not be accurately predicted using the currently implemented machine learning approach.

In conclusion, we demonstrate that attachment security is an important predictor of relationship quality during the unstable times of the COVID-19 pandemic, in comparison to fear, sexuality and environmental factors such as the stringency of movement restrictions.

Table 1. Input features used to predict reported relationship quality and change in relationship quality.

Target	<i>Relationship quality and change in quality</i>	377	
Features	Country, viral spread and mortality, stringency of restrictions	378	
	Age+	379	
	Sex	380	
	Sex. orientation	381	
	ECR-R anxiety+	382	
	ECR-R avoidance	383	
	Mean fear	384	
	Having children	385	
	Health	386	
	Sexual activity	387	
	Sexual satisfaction	388	
	Physical contact	389	
	Kissing	390	
	Discussing	391	
	Living with partner	392	
	Tolerance	393	
	Joint activity+	394	
	Time investment+	395	
	Conflicts+	396	
	Relationship duration		<i>Note.</i>
			Features with a

median permutation feature importance (PFI) greater than 0.05 for the target relationship quality are marked with '+'. None of the features had a median PFI greater than zero for the target change in relationship quality.

Figure 1. Permutation feature importance (A) and model-based feature importance (B) over linear models with relationship quality as a target.
C) Use of attachment security (overall score) as a predictor by the non-linear models.

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