Cooperation after Divorce:

A Randomized Controlled Trial of an Online Divorce Intervention on Hostility

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Abstract

Objective: For many, the divorce process is associated with various degrees of hostility. Such hostility may have implications for a variety of interpersonal relationships, including relationships with the ex-partner, extended family, friends, and coworkers. The current study presents the results of a one-year longitudinal randomized controlled trial of the “Cooperation after Divorce” (CAD) online intervention platform for adults going through a divorce.

Method: Participants included 1,856 divorcees who began the intervention, on average, within one week of legal divorce. Participants responded to the SCL-90R hostility subscale at baseline, and at 3, 6, and 12 months post-divorce.

Results: Data analyses consisted of mixed effects modeling and one-sample t-tests. The study found that the intervention platform significantly reduced hostility among divorcees over a one-year period, with an effect that was medium in size. Of note, there were no gender differences in the reduction in hostility over the 1-year period, suggesting that the intervention was equally beneficial to men and women. Moreover, after one year, in the intervention group, but not the control group, levels of hostility were reduced to normative national hostility levels.

Conclusion: The results suggest that recently divorced people benefit from the online intervention platform in terms of significantly reduced hostility and suggest that the intervention platform may thereby offer long-term public health benefits given previously found associations between higher levels of hostility and health.

Keywords: Hostility, Divorce, Online Intervention, Randomized controlled trial, Longitudinal, Cooperation after Divorce (CAD)
Cooperation after Divorce:

An RCT study on the Effects of an Online Divorce Intervention Platform on Hostility

In both the U.S. and the European Union, approximately 40 to 50% of marriages end in divorce (Center for Disease Control and Prevention, 2016; European Commission, 2015). Further, marital dissolution is associated with a host of negative consequences, such as poorer psychological functioning (e.g., increased stress and depression; Breslau et al., 2011; Nielsen, Curtis, Kristensen, & Rod Nielsen, 2008), worse physical health (Lorenz, Wickrama, Conger, & Elder, 2006), and the loss of social support (e.g., loss of support from ex-spouse or friends; Kołodziej-Zaleska & Przybyła-Basista, 2016). Moreover, divorcees often have to adjust to new living circumstances (Fabricius & Luecken, 2007), may experience lifestyle and identity changes as they transition from married to divorced, and often face economic decline or difficulties post-divorce (Amato, 2000). These negative consequences may vary by gender, such that women may experience steeper (and faster) declines in income levels and living standards compared to men after marital dissolution (Bianchi, Subaiya, & Kahn, 1999; de Vaus et al. 2015; Gadalla, 2008; Leopold, 2018). Men, conversely, report experiencing more loneliness and often have smaller support networks, and they report higher engagement in health-risk behavior, worse health status, and have higher mortality risk (Berntsen & Kravdal, 2012; Dykstra & Fokkema, 2007; Sbarra, Law, & Portley, 2011; Waite, Luo, & Lewin, 2009).

Among the negative consequences of divorce may be higher levels of hostility (Rodrigues, Hall, & Fincham, 2006), whether expressed through thoughts, feelings, or actions. For instance, hostility, as conceptualized in the current study, includes feelings of annoyance and irritation, desires to exert harm on others, and actions expressing hostility, such as shouting and throwing things. These thoughts, feelings, and actions may be responsive to major life events, such as undergoing a divorce. Specifically, people may experience increased depression, anxiety, and stress.
in response to a major life event such as divorce (e.g., Hobson & Delunas, 2001; Kessing Agerbo, & Mortenson, 2003). Moreover, hostility is conceptualized as a key component and primary symptom dimension of psychological distress (Derogatis, 1977; 1994). Such distress may manifest in externalizing thoughts, feelings, and behavior (Bridewell & Chang, 1997), which may be directed at others, regardless of their involvement in the divorce.

In the context of divorce, hostility may hamper cooperation and co-parenting and increase levels of conflict between ex-spouses (e.g., López Larrosa, Sánchez-Souto, & Ruiz De Aalda, 2012). There may be a spillover effect across relationships (e.g., Erel & Burman, 1995), such that hostility with a former partner may lead to hostility in other contexts in everyday life. Moreover, hostility may lead to increased aggression (Eckhardt, Norlander, & Deffenbacher, 2004; Lindsay & Anderson, 2000), whether with respect to former partners, children, or others (e.g., extended family, friends, coworkers). While, for some, hostility levels and conflicts tend to decline over time as a natural part of post-marital adjustment (Hackney & Ribordy, 1980; Whiteside, 1998), for others, hostility and conflict continue long after the initiation of the divorce process (Johnston, 1994; Prutt, Nangle, & Bailey, 2005; Wallerstein, 1986). Though the majority of research has examined partner-specific hostility, this may also be true for general hostility, as distress is linked with hostile behavior in some cases (Curtis, 1982; Genuchi, 2015). While the research is divergent with respect to the trajectory of hostility over time, post-divorce hostility may be an apt focus for interventions, in part because of the associated negative intra- and interpersonal consequences (e.g., Johnston, 1994; López Larrosa et al., 2012; Tschann et al., 1989). Of note, some research suggests that gender differences in post-divorce hostility and anger may exist, such that women experience higher levels of hostility compared to men (Dreman & Aldor, 1994; Hilton & Kopera-Frye, 2004). In this research, hostility and anger were measured as general characteristics, suggesting that post-divorce hostility may occur in a general, non-partner-specific, form. However, no research to our
knowledge has examined whether longitudinal trajectories in post-divorce hostility differ by gender. The current study examines post-divorce hostility among a sample of recently divorced Danes, and investigates whether an online intervention ameliorates hostility for both men and women.

**Divorce Interventions**

As divorce is associated with poorer psychological outcomes for both divorcees and their children, there has been a call for scalable cost-effective evidence-based interventions to reduce these effects (e.g., Bowers, Mitchell, Hardesty, & Hughes, 2011; Salem, Sandler, & Wolchik, 2013). Various programs have been developed (e.g., Bowers, Ogolsky, Hughes, & Kanter, 2014), many of which rely on an in-person involvement component. However, some people may be hesitant to participate in such programs, for a variety of reasons, including time, convenience, and costs. Thus, online interventions may offer a number of advantages, such as greater outreach to audiences that may otherwise be excluded from traditional face-to-face interventions, convenience, affordability, scalability, reduced stigmatization, self-monitoring of progress through the intervention, and the ability to expand contents and parental support beyond classroom or face-to-face interactions (Bower et al., 2011; Greenberg, Fidler, & Saini, 2019). However, scientific evaluations of these online programs are minimal to nonexistent (Bowers et al., 2011). One study examined the relative effectiveness of an in-person group-based divorce education program versus an identical online version of this program, finding that the online program was about as effective as the in-person program (Schramm & McCaulley, 2012).

Nevertheless, their design lacked the use of a control group, a key element in examining the effectiveness of the intervention. Moreover, it lacked normed and validated measures allowing for comparisons of outcomes over time with general divorcee or background populations. Thus, longitudinal randomized controlled trials, using normed and validated outcome measures, are essential in the examination of the effectiveness of divorce interventions (Bowers et al., 2011, 2014;
Greenberg et al., 2019; Schramm & McCaulley, 2012). Such investigations may also better inform policymakers and clinicians about the effectiveness of online digital divorce interventions and programs (Andersson, Rozental, Titov, Dear, & Carlbring, 2019; Greenberg et al. 2019).

The Current Study

Some people may experience higher levels of hostility post-divorce (e.g., Hilton & Kopera-Frye, 2004; Sbarra & Emery, 2005), whether directed at the ex-partner or others. Given the high prevalence of divorce and given that divorce affects more people than just the couple, heightened levels of hostility may have profound implications for the mental health of a number of people. Little research has focused on general hostility experienced post-divorce, despite the fact that it may have important negative implications for general functioning (e.g., interpersonal relationships and working relationships). Adding to this gap, there is also little published research on divorce outcomes in the Danish population (for an exception, please see Kessing et al., 2003). Thus, interventions aimed at assisting those undergoing divorce may be of great public health interest. However, to date, few online interventions have been created and scientifically examined, particularly interventions addressing factors that are associated with increased hostility. To address this gap in knowledge, the present study presents the results of a one-year longitudinal randomized controlled trial (RCT) digital intervention, focusing on the reduction of self-reported hostility levels among recently divorced individuals. Specifically, we sought to examine the following research questions:

RQ1: Do the CAD intervention group experience greater reductions in hostility than the control group, and if so, does the reduction hold over a one-year period?

RQ2: Do the trajectories of change in hostility over time differ by gender?

RQ3: How do hostility levels among a large sample of Danish divorcees 1 year post-divorce compare to the hostility levels of the general population?
Methods

Participants

The sample comprised 1,856 recently divorced Danes (66.8% women); approximately 88% were first-time divorcees. People were on average 45.32 years old ($SD = 8.66$ years), and had been married for an average of 12.74 years ($SD = 8.03$ years). The majority of the sample (88.3%) were parents, with an average of 1.88 ($SD = .99$) children per participant; the average age of the children was 13.50 years ($SD = 8.16$ years). Most of the participants had at least a medium-length education (i.e., medium-length tertiary education, such as a bachelor’s degree; 36.3% low level of education, 37.3% medium level of education, 26.4% high level of education, please see measures section) and at least an average salary (40.5% below average salary, 43.5% average salary, 15.9% above average salary; please see measures description). For a further description of the sample, please see Table 1.

Response rates. Participants were invited to the study through e-mailed letters sent out by the Danish State Administration (DSA), together with the divorce decree. As the DSA is unable to provide the exact number of study links sent during the trial inclusion period (i.e., January 2016 to January 2018), we cannot provide the exact study response rate. However, 1,882 people initiated the study and were randomized to the trial. Of these, 26 were excluded due to incomplete baseline responses (see Figure 1). Accordingly, a total of 1,856 participants were included in analyses.

Representativeness of the final sample. In order to assess if those who elected to participate in the study significantly differed from the Danish divorcee population, socio-demographic data for all people who divorced in Denmark during the study period was obtained from Statistics Denmark (see also the CONSORT diagram in Figure 1). The sample was representative in terms of age, income, and marriage duration. In the study sample, there were more female participants ($X^2 (1, N = 1856) = 208.45$, $p < .001$), more highly educated participants ($X^2 (2, N =1856) = 1135.23$, $p < .001$),
and on average participants had fewer previous divorces ($t(1855) = -8.47, p < .001$) than the Danish divorce population during the study period.

**Randomization bias.** A randomization schedule was set up so that participants were assigned to either the intervention or control group sequentially over two week periods. This resulted in a total of 27 recruitment rounds for the intervention group and 27 recruitment rounds for the control group (i.e., 108 weeks in total). The assignment schedule was blinded to the researchers, due to heavy media- and public policymaker interest for the intervention; that is, at certain times during the data collection process, the intervention received a lot of media coverage, which may have influenced the likelihood of divorcees to join the study during these periods. Hence, this likely also explains the uneven allocation ratios (i.e., control group 44.5%; intervention group 55.5%). With respect to the participants assigned to the intervention group, less than 1 percent ($n = 8$) elected not to use the intervention (i.e., initiated no modules).

To determine if possible selection bias was produced during the randomized allocation into the intervention or the control group, a multiple logistic regression was performed with group membership as the criterion variable and sociodemographic variables (gender, age at baseline, education, income), divorce-related characteristics (times divorced, marriage duration, parenthood status, conflict degree with a former spouse), and relevant health-related variables (depression, anxiety, stress, and mental and physical health) as predictor variables. No significant differences in any of the variables were found, indicating that the randomization was successful (for details, see Table 1).

**Attrition rate.** The initial study sample reduced in size in the intervention group by 72.1% from baseline (T1) ($n = 1,050$) to 3 months follow-up (T2) ($n = 293$), and in the control group by 70.2% from T1 ($n = 832$) to T2 ($n = 248$), but stabilized in subsequent follow-ups at 6 months (T3) and 12 months (T4) (intervention group: $T3 = 254$ and $T4 = 230$; control group: $T3 = 212$ and
T4 = 190). This attrition rate is consistent with the high dropout rates of other longitudinal online eHealth studies (e.g., Donkin et al., 2011; Eysenbach, 2005; Geraghty, Torres, Leykin, Pérez-Stable, & Muñoz, 2013).

**Attrition bias.** To determine if the attrition rate resulted in an attrition bias, multiple logistic regression analyses by group were performed to compare participants who dropped out after baseline to those who remained in the study using baseline information. Predictors were sociodemographic variables (gender, age at baseline, education, income), and divorce-related characteristics (times divorce, marriage duration, parenthood status, conflict degree with a former spouse), and mental and physical health indicators (depression, anxiety, somatization, stress, mental and physical health). It was observed that younger age (AOR = - .99, p < .05) and poorer physical health (AOR = .90, p < .01) predicted baseline drop-out. For the control group, no predictors were significant. Thus, attrition bias was found to be modest.¹

**Procedure**

These data are part of a 12-month longitudinal randomized controlled trial (RCT) of post-divorce online intervention study entitled ‘Cooperation after Divorce’ (CAD) that was initiated in July 2015 in collaboration with the Danish State Administration (DSA). The objective was to assess the effects of the CAD intervention platform on well-studied adverse effects often experienced as a consequence of divorce. Outcome measures included health-related quality of life, perceived stress, anxiety, depression, hostility, somatization, parent reports of children’s health-related quality of life, sick days, and days of absence from work. From July 2015 to the end of December 2015, the intervention was trialed to test whether the user functionalities and the data collection process worked according to plan. After this ‘test run’ period, the randomization to conditions was initiated

¹ Moreover, in order to conservatively account for attrition bias influencing the analytical results, all variables were included as controls in the main analyses. Study attrition bias was again found to be modest and the patterns of results mostly held when these variables were included. The results are detailed below and further details are provided in the Supplementary materials.
and the RCT was carried out, running from January 2016 to January 2018. Throughout the study period, Danish citizens who wanted to divorce initiated the legal divorce and separation procedures by submitting an application to the DSA. Divorce was granted immediately when both spouses agreed to the divorce. If there were disagreements to divorce terms or to the divorce itself, a six-month separation period was initiated, after which legal divorce was granted even if a mutual agreement had not been reached; according to the DSA, this occurred in nearly 30% of cases. It took an average of 2-3 weeks for divorce decrees to be issued by the DSA in mutual agreement divorces.

For this study, the DSA electronically sent information about the study and an invitation letter to participate along with the divorce decree. People who decided to participate used a web link enclosed, created an account on the CAD website, provided informed consent, responded to the baseline survey, and were then randomized to either the intervention or the control group following the randomization schedule described above (see the section on randomization bias). The intervention group received access to the online intervention while the control group was not exposed to any of the modules. The control group was not offered any systematic help during the 12 months study period (i.e., a no-treatment or treatment as usual group), nor did they receive access to the materials after the end of the study. Neither group was offered compensation for participation (other than access to the intervention for the intervention group), though control group members were entered into a raffle for cinema tickets. On average, participants completed the baseline survey 4.73 days ($SD = 7.10$ days) after obtaining their juridical divorce. Participants were sent three follow-up questionnaires at 3-, 6-, and 12-months post-divorce to the email they had provided when responding to the baseline questionnaire.

Responses were anonymized and stored in an anonymous form on a secure server. The study was approved by the Danish Data Protection Agency. The study was exempt from further ethical
evaluations following the rules and regulations set forth by the Scientific Ethical Committees of Denmark.

Measures & Materials

Sociodemographic variables. Several sociodemographic variables were assessed: a) *Age at divorce* was measured in years and months. b) *Gender* was coded 1 = “Male” and 2 = “Female”. c) *Education level* was assessed by the highest level of completed formal education, consequently making three categories: 1 = “Low level of education” (e.g. primary school, high school, business high school, vocational education), 2 = “Medium level of education” (e.g. medium-length tertiary education, bachelor’s degree) and 3 = “High level of education” (e.g. master’s degree or higher). d) *Monthly income* was reported on a nine-point scale with 10,000 DKK intervals (app. 1,500 USD intervals), from 1 = “below 10,000 DKK” (i.e., below 1,500 USD) to 9 = “more than 80,000 DKK” (i.e., approximately 12,000 USD). At the time of the intervention, 1 USD approximated 6.50 DKK, and subsequently recoded into: 1 = “Below national average”, 2 = “National average” and 3 = “Above national average”.

Marriage and divorce-related variables. We also assessed a variety of marriage and divorce-related variables: a) *Marriage duration* was calculated in years and months from the marital date to the juridical divorce date. b) *Legal divorce duration* was calculated in months from the juridical divorce date to the baseline survey response date. c) *Number of divorces* was obtained by asking participants, “How many times have you divorced?” with response options including 1 = “One time”, 2 = “Two times”, 3 = “Three times” and 4 = ”More than three times”. d) *Parenthood status* and *Number of Children* were determined by asking the number of children the participants had. e) *Children’s age* was calculated from the birthdate of the children as provided by respondents and to the baseline survey response date. f) *Degree of conflict* was assessed by the 6-item self-report Divorce Conflict Scale (DCS). The DCS assesses six dimensions of divorce-related conflict:
communication, co-parenting, global assessment of former spouse, negative and pervasive negative exchanges and hostile, insecure emotional environment, self-perceived conflict (Hald, Strizzi, Ciprić, & Sander, 2020). The internal consistency of the scale was high (α = 0.88).

**Individual Differences.** We assessed various individual difference variables that were used in the randomization bias analyses. Specifically, a) *Physical Health* and *Mental Health* were assessed using the SF-36 (Ware, Snow, Kosinski, & Gandek, 1993). b) *Stress* was measured using the Danish version of the Perceived Stress Scale (PSS; Eskildsen et al., 2015), and c) *Somatization, Anxiety and Depression* symptoms were measured using the Danish version (Derogatis, 2009) of The Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 2000).

**Hostility.** Hostility was assessed using the Danish version (Derogatis, 2009) of the 6-item hostility subscale of the Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 2000). Items include “Getting into frequent arguments” and “Having urges to beat, injure, or harm someone.” Questions were asked with respect to the previous week and were evaluated using 5-point Likert-type response options, with higher scores representing higher levels of hostility (0 = not at all; 4 = very much). The instrument demonstrated high internal consistency at all four data collection waves (Cronbach’s α = .78-.82) and stability over time (r = .66 - .49). Previous research has demonstrated good validity and reliability of the scale (Derogatis, 2000).

**The CAD intervention.** The CAD digital intervention platform is comprised of digital learning modules, which are accessed online from a computer, mobile device, or tablet. Each module takes approximately 20-45 minutes to complete. The contents of the modules target well-known challenges often relevant to divorcees (Hald & Sander, 2019). These challenges are arranged into three main areas and divided into 17 divorce-related themes (learning modules). These are:
1) *Yourself*, which consists of six themes: a) how divorce affects you, b) let go and forgive, c) coping with grief, d) ways to deal with negative thoughts, e) how to handle crisis, and f) anger management.

2) *The Children*, which covers the following four themes: a) how children experience divorce, b) understanding children’s feelings and reactions, c) putting children’s needs first, and d) how to communicate with children about divorce.

3) *Co-parenting*, comprising seven themes: a) avoiding typical pitfalls, b) making clear agreements, c) how to get through holidays and birthdays, d) roads to good co-parenting communications, e) dealing with conflicts, f) create good co-parental cooperation, and g) find common ground in child-rearing (Hald & Sander, 2019).

The overall objectives of the modules are to provide a combination of knowledge and tools, designed to increase the likelihood of learning relevant coping strategies and achieve adequate attitudinal and behavioral changes. Accordingly, each module includes psychoeducation, exercises, questions, and/or dilemmas. Two core communication and interaction principles were applied throughout the modules: 1) A minimum of text is used and content consisted of ‘rich media’ such as video, animation, illustrations, pictures, and voice-overs, and 2) User activation so that users are activated every 2-5 minutes with exercises, questions, and/or dilemmas. Members of the intervention group choose which modules to engage with and when. For instance, several modules concerned children and co-parenting; those divorcees, who did not have children, were able to skip these modules, as that material may have been irrelevant to their situation. This individually tailored approach was employed because divorce is a heterogeneous process and the experience and needs of divorce may change from one individual to the next. As the intervention is individually tailored, the ideal dosage cannot be calculated. In the current study, participants on averaged used 4.27
modules (SD = 2.94). For a more detailed description of CAD, please see the Supplementary Materials.

**Plan of Analysis**

Prior to data collection, a formal a priori power analyses was not conducted, as no study of this type had been conducted before to provide effect size estimates. Rather, the aim was to include participants on a scale that would enable us to detect effects similar to small effect sizes (.20) as measured by Cohen's (d) with a p-value of .05 (alpha), a beta value of .80, and an estimated drop-out rate of 50%. Based on these assumptions, it was anticipated that the total sample size should be 2,664 participants (1,332 participants per group).

Data is analyzed and reported under a conservative intention to treat (ITT) assumption (Gupta, 2011), and all participants, who were randomized to intervention/control conditions, are included in the statistical analysis. Attrition bias was assessed (please see participant section), and any data available from participants were included with a full information maximum likelihood (FIML) estimation approach to missing data in fitting the models (Little, 2013), to enable robustness of the longitudinal estimates.

We first examined the inter-correlations among hostility scores at baseline, 3-, 6-, and 12-month follow-ups separately for the intervention and control groups. We then conducted a series of linear mixed effects model analyses; these analyses were carried out using the lme4 (version 1.1-17) package for R (version 3.5.3). In these analyses, two primary predictors were entered: measurement time points (baseline, 3-months, 6-months, and 12-months) and group membership (intervention vs control group). Both time point and group membership were treated as categorical variables. We also added an interaction term between measurement time and group membership, which allowed us to examine whether the groups differed across the time points. Thus, we were able to examine the full response trajectory, using all participants and with an unrestricted time effect. Individual
differences in initial levels of the outcomes were accounted for by a random intercept. Following up on these primary analyses, 1) we examined whether the results held when accounting for potential attrition bias, and 2) we tested whether the effects of the intervention differed by gender.

These mixed effect models were followed up by comparing hostility scores at the 12-month follow-up to normative data from a nationally representative study conducted in Denmark (Derogatis, 2009; Olsen, Mortensen, & Bech, 2006) using one-sample *t*-tests. These tests were conducted for the intervention and control groups separately, as well as stratified by gender.

**Results**

**Correlations and Descriptive Data**

Table 2 displays the intercorrelations among hostility scores across time points, along with means and standard deviations. We found that these were all positively and significantly associated; moreover, these correlations were of medium strength. For the control group, hostility scores were unrelated to gender, while for the intervention group, hostility scores were positively and significantly correlated with gender, such that women reported greater hostility than men. However, these correlations were small in magnitude.

**Mixed Effects Models**

To examine whether the groups evinced differences in hostility across the measurement points (RQ1), we conducted several mixed effect model analyses. Table 3 provides the primary results, and Figure 2 depicts the trajectory of change over time for the two groups. Within Table 3, treatment effects are quantified as mean differences at 3-, 6-, and 12-months. Moreover, the treatment effects at each time point are also reported as Cohen’s *d* effect size as inferred from the

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2 We also examined whether there was a dose-response effect (i.e., exposure to more modules is associated with less hostility). In examining total modules engaged in (whether completed or merely started) for those in the intervention group, we did not find evidence of this, *b* = 0.006, *p* = 0.0305, Cohen’s *d* = 0.013. However, we urge caution in interpreting this as reflecting a no dose-response effect, as it is unclear when and how much participants used the modules.
model fit (i.e., the mean difference divided by the standard deviation on the considered outcome). As expected, those in the intervention group did not differ from those in the control group at baseline. Those in the control group did not report significant changes from baseline levels of hostility at 3-, 6-, or 12-months follow-up. The intervention group, however, reported significantly lower levels of hostility, as compared to the control group, at all three time points. These differences were moderate to large in size (Table 3, unadjusted estimates). To test for the presence of any effect of the intervention, we compared the model fit of the current model to a model that omitted the interaction effect between time and group membership (i.e., a model suggesting no effect of group assignment at any time point), using a likelihood ratio test. The results suggested that the model specifying an intervention effect fit the data better than the model with no intervention effect ($\chi^2(4) = 66.807, p < .001$). Thus, there was a significant effect of the intervention.

We repeated the analyses, controlling for gender, age, education, income, times divorced, number of children, duration of marriage, conflict degree, physical and mental health, and stress levels, to ensure that attrition did not influence the results. The main results can be found in Table 3 (adjusted estimates; see also supplemental materials for a full results table and figure). Again, we found that the two groups do not differ at baseline, and that there were no significant changes from baseline levels of hostility at 3-, 6-, or 12-months follow-up for the control group. There remained significant differences between the control group and the intervention group at 6- and 12-months follow-up; these effects were attenuated, however, and were small to moderate in size. The likelihood ratio test suggested that the model omitting the intervention effect did not fit the data better than the model with intervention effect ($\chi^2(4) = 9.445, p = 0.051$). Thus, there was a significant effect of the intervention.

Lastly, given that the literature suggests the possibility that men and women may differ in their levels of hostility, we examined whether a model with an interaction between group
membership, time points, and gender fit the model better than a model with an interaction between group membership and time point only (RQ2). In an effort to be conservative, we included the above-mentioned covariates. We found that that was not the case ($\chi^2(7) = 3.172, p = 0.869$), suggesting that men and women did not differ with respect to changes in hostility levels over time as a function of their group membership.

**Comparison to Norms**

To examine how hostility levels in our sample compared to those of the general population (RQ3), we compared scores at 12-month follow-up to norms from the general Danish population (Olsen, Mortensen, & Bech, 2004). Figure 3 displays the results. Overall, we found that both men ($t(45) = 2.37, p = 0.022, \text{Cohen's } d = 0.350$) and women ($t(127) = 4.75, p < 0.001, \text{Cohen's } d = 0.420$) in the control group scored significantly higher on hostility compared to general population norms. Conversely, men in the intervention group scored significantly lower compared to general population norms ($t(79) = -2.78, p = 0.007, \text{Cohen's } d = -0.311$) while women in the intervention group reported hostility levels on par with the general population norms ($t(131) = -0.41, p = 0.680, \text{Cohen's } d = -0.036$).

Following generally recommended cut-off values for problematic levels of hostility in the Danish population (males = 0.76, females = 0.85; Olsen et al., 2006), we found that at 12-month follow-up, 23.91% of males and 24.22% of females belonging to the control group scored equal to or higher than the recommended cut-off value. In comparison, in the intervention group, only 7.5% of male participants and 12.12% of female participants scored equal to or higher than the recommended cut-off value.

**Discussion**

The current study is among the first to examine post-divorce trajectories of hostility among a sample of recently divorced individuals. Moreover, it is the first to present results of a longitudinal
RCT testing the effects of an online intervention platform which contained components that may have aided in the reduction of hostility. The results indicated that those who participated in the online intervention reported reduced general hostility and that the effect was also evident at one-year follow-up (RQ1). In fact, hostility was reduced to be on par with or lower than a normative sample of Danes (RQ3). Conversely, those who did not have access to the online platform displayed elevated levels of hostility at the 12-month follow-up, with roughly one quarter evincing levels of hostility that may be considered problematic (Olsen et al., 2006) (RQ3). Indeed, the results of the mixed effects modeling suggested that those in the intervention group experienced significant reductions in hostility across the study period (RQ1). It is also noteworthy that the reduction in hostility over time for the intervention group did not differ by gender (RQ2). Research suggests that there are gender differences in anger and hostility (Hilton & Kopera-Frye, 2004; Kring, 2000), with women reporting higher levels of general hostility post-divorce than men. Thus, while mean differences may exist between genders, both men and women saw benefits from the intervention in terms of equal rates of reduced hostility.

One reason for the reductions in hostility may be that there was a corresponding reduction in emotional distress indicators, such as depression, anxiety, and stress (Cipric et al., in press; Hald et al., in press). Indeed, hostility is conceptualized as a key component and primary symptom dimension of psychological distress (Derogatis, 1977; 1994) (though some have argued that hostility is an independent factor, to be distinguished from depression and anxiety; Bridewell & Chang, 1997). That is, for some, emotional distress may manifest in hostile thoughts, feelings, and behavior (Bridewell & Chang, 1997), whether expressed externally or internally. By addressing aspects of the divorce process that may cause emotional distress, such as depression, anxiety, and stress, the intervention may have indirectly affected people’s hostile reactions to the divorce situation. Relatedly, some work has found that hostility predicts risk of developing depression
(Ingram, Trenary, Odom, Berry, & Nelson, 2007), and a reduction in hostility may furthermore reduce the subsequent risk of developing depression post-divorce.

Although the current investigation examined general hostility, rather than partner-specific hostility, we speculate the current findings also have implications for partner-specific hostility. Specifically, past research suggests that stress and negative emotions may fuel hostility, which may result in aggression (Berkowitz, 1993; Eckhardt et al., 2004). Thus, it may be that the negative feelings associated with going through a divorce may also increase hostility, which some research suggests is linked to intimate partner violence perpetration (Norlander, & Echhardt, 2005; Schumacher, Feldbau-Kohn, Slep, & Heyman, 2001). The intervention tested in this RCT covers many topics, which may, directly or indirectly, influence negative emotions and actions, including hostility. As the intervention yielded significantly lower levels of hostility over the study period, these reductions may also reduce the chances of IPV between ex-partners. Previous research suggests that in particular, hostile attributions (i.e., interpreting others' behaviors as having hostile intent) may be a key factor in predicting IPV perpetration (e.g., Holtzworth-Munroe & Hutchinson, 1993), and it may be that the material in the intervention assisted in lessening the tendency to make such hostile attributions. We encourage future research studies to specifically investigate this

Limitations

While the current study has many strengths, including the use of normed and validated measures and a longitudinal design, there are also some weaknesses, which should be taken into account when evaluating the results. General self-selection bias may have led to people with higher levels of hostility to be over-represented in the study; these individuals may have believed that the intervention platform would be particularly helpful to them. However, on the other hand, those with higher levels of hostility may also be under-represented as they may have decided not to participate because it may have felt threatening to their sense of self (DiBello, Neighbors, & Ammar, 2015;
Howell & Sheppard, 2012). The high attrition rate, though comparable to other studies (e.g., Donkin et al., 2011; Geraghty et al., 2013), could have introduced an attrition bias although we found only few significant differences in terms of the variables we examined.

Further, while we found a significant reduction in hostility over time, the measure used did not assess hostility specific to the partner, but rather, general hostility. However, this may also be seen as a strength, as higher levels of hostility may be damaging to relationships other than with the ex-partner, such as family, friend, and work relationships. Thus, reductions in general hostility may be more beneficial to people than reductions in partner-specific hostility.

Lastly, the study does not investigate likely moderators of the intervention effect such as intervention user patterns, sociodemographic factors (except for gender), or divorce-related characteristics, which may be important factors to consider (Amato, 2000; Kołodziej-Zaleska & Przybyła-Basista, 2016; Symoens Bastaits, Mortelmans, & Bracke, 2013).

**Research Implications**

Therefore, there are a number of possible future directions in examining the efficacy of the intervention. Specifically, future studies should examine whether the intervention effects on hostility varies as a function of various demographic factors. For instance, in the current study, we did not obtain information about sexual orientation. While, in Denmark, less than 100 couples of the same gender divorce each year, it would be interesting to examine in future studies whether the reduction in hostility, as a function of the intervention, differ by sexual orientation. Moreover, while the Danish population is somewhat homogenous with respect to ethnic and religious background, future research would also benefit from examining whether reductions in hostility vary by these factors or the effects hold across cultures. Of note, invitations were only sent to Danish citizens where one or both lived in Denmark; thus, non-citizen immigrants or asylum seekers were not included in the study. Finally, studies have found that divorcees with low socioeconomic status, compared to their...
married counterparts and divorcees with high socioeconomic status, have worse health status, higher suicide rate, higher risk of overall mortality risk (Choi & Marks, 2011; Lorant et al., 2005; Symoens, Van de Velde, Colman, & Bracke, 2014), so it may be of interest to examine whether the intervention might be particularly useful for this social group.

**Prevention, Policy, and Clinical Implications**

These findings may be useful from a number of prevention, clinical, and policy perspectives. For one, as research suggests that going through a divorce is a major life event that may be associated with increased stress and depression (Hobson & Delunas, 2001; Kessing et al., 2003), the outcomes of the current investigation suggest that implementing an easy-access online intervention may be useful in improving the mental and physical health outcomes of those undergoing a divorce. From a public health perspective, an online platform such as the CAD tested here may present a viable prevention strategy, as individuals could be offered access to the platform immediately upon filing for divorce, thereby reducing symptoms of hostility and distress. In line with this, public policymakers may wish to mandate the offering of the intervention, through either health care providers, the public court system, or other government entities.

While the current investigation, as well as others (Cipric et al., in press; Hald et al., in press; Sander et al., under review; Schramm & McCaulley, 2012), demonstrates the usefulness of an online intervention, it may be beneficial to pair it with a “warm hands” component. This “warm hands” approach could take several forms. For one, people seeking clinical help may find the online intervention useful in addition to seeing the therapist, as the modules may address common issues that divorcees face every day and which they may want help with without having to wait for the next therapy session. Thus, a combination of face-to-face clinical assistance and online psycho-education may yield even better outcomes in terms of reduced hostility and distress, and may make therapy sessions more targeted, as the therapist and client may be able to work on idiosyncratic
topics and issues not addressed by the intervention modules. Alternatively, for those who may be disinclined to see a therapist face-to-face, a “warm hand” may present itself in the form of an online contact system, where divorcees may be able to contact a clinician to ask questions and receive feedback. The contact system could also present itself as an online discussion forum, where divorcees with similar problems may be able to communicate, providing a sort of support group.

Conclusion

Using an RTC study design, the Cooperation after Divorce intervention was shown to be effective in reducing self-reported hostility among recently divorced Danes during their first year post-divorce. Moreover, at the 12-month follow-up, those in the intervention condition reported hostility levels that were on par or lower than a normative sample of Danes. These results have potential implications for the services offered to newly divorced individuals and suggest the utility of an online digital intervention platform that is accessible, on-demand, to a large part of the population with content tailored to issues especially relevant to meet people’s needs as they transition from married to divorced.
References


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http://dx.doi.org/10.1080/10502556.2012.721301
http://dx.doi.org/10.1016/S1359-1789(00)00027-6


http://dx.doi.org/10.1016/j.ssresearch.2008.07.001


Table 1. Descriptive Sample Characteristics of Recently Divorced Danes

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 825)</th>
<th>Intervention (n = 1031)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender (women), %</strong></td>
<td>67.8</td>
<td>66.0</td>
</tr>
<tr>
<td><strong>Age, M (SD)</strong></td>
<td>45.3 (8.6)</td>
<td>45.4 (8.7)</td>
</tr>
<tr>
<td><strong>Level of education, %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>36.0</td>
<td>36.6</td>
</tr>
<tr>
<td>Medium</td>
<td>40.0</td>
<td>35.1</td>
</tr>
<tr>
<td>High</td>
<td>24.0</td>
<td>28.3</td>
</tr>
<tr>
<td><strong>Income, %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below average</td>
<td>42.8</td>
<td>38.7</td>
</tr>
<tr>
<td>Average</td>
<td>42.4</td>
<td>44.4</td>
</tr>
<tr>
<td>Above average</td>
<td>14.8</td>
<td>16.9</td>
</tr>
<tr>
<td><strong>Being a parent, %</strong></td>
<td>87.4</td>
<td>88.9</td>
</tr>
<tr>
<td><strong>Number of children, M (SD)</strong></td>
<td>1.9 (0.96)</td>
<td>1.9 (1.0)</td>
</tr>
<tr>
<td><strong>Times divorced, %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 time</td>
<td>87.3</td>
<td>88.1</td>
</tr>
<tr>
<td>2 times</td>
<td>10.9</td>
<td>9.8</td>
</tr>
<tr>
<td>3 times</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>More than 3 times</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Marriage duration, M (SD)</strong></td>
<td>12.6 (8.1)</td>
<td>12.8 (8.0)</td>
</tr>
<tr>
<td><strong>Conflict degree (0 – 27°), M (SD)</strong></td>
<td>13.7 (4.8)</td>
<td>13.8 (5.0)</td>
</tr>
<tr>
<td><strong>Modules Used (0 – 17°), M (SD)</strong></td>
<td>0.00 (0.00)</td>
<td>4.3 (2.9)</td>
</tr>
<tr>
<td><strong>Mental Health Indicators, M (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Health</td>
<td>57.9 (8.1)</td>
<td>57.9 (8.1)</td>
</tr>
<tr>
<td>Mental Health</td>
<td>34.5 (13.6)</td>
<td>34.4 (13.5)</td>
</tr>
<tr>
<td>Stress (0 – 40°)</td>
<td>19.5 (7.1)</td>
<td>19.5 (7.0)</td>
</tr>
<tr>
<td>Somatization (0 – 4°)</td>
<td>0.78 (0.72)</td>
<td>0.79 (0.71)</td>
</tr>
<tr>
<td>Hostility (0 – 4°)</td>
<td>0.62 (0.60)</td>
<td>0.66 (0.65)</td>
</tr>
<tr>
<td>Anxiety (0 – 4°)</td>
<td>0.88 (0.78)</td>
<td>0.91 (0.80)</td>
</tr>
<tr>
<td>Depression (0 – 4°)</td>
<td>1.46 (0.94)</td>
<td>1.47 (0.94)</td>
</tr>
</tbody>
</table>

*Note. There were no significant differences between groups. *Possible value range.*
Table 2. Correlations between Average Hostility Scores at each Time Point

<table>
<thead>
<tr>
<th>Cross-correlations</th>
<th>Hostility T1</th>
<th>Hostility T2</th>
<th>Hostility T3</th>
<th>Hostility T4</th>
<th>Gender</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hostility T1</td>
<td>--</td>
<td>0.64***</td>
<td>0.54***</td>
<td>0.50***</td>
<td>0.06*</td>
<td>0.66 (0.65)</td>
</tr>
<tr>
<td>Hostility T2</td>
<td>0.63***</td>
<td>--</td>
<td>0.66***</td>
<td>0.52***</td>
<td>0.12*</td>
<td>0.46 (0.52)</td>
</tr>
<tr>
<td>Hostility T3</td>
<td>0.57***</td>
<td>0.63***</td>
<td>--</td>
<td>0.57***</td>
<td>0.10</td>
<td>0.35 (0.42)</td>
</tr>
<tr>
<td>Hostility T4</td>
<td>0.57***</td>
<td>0.68***</td>
<td>0.68***</td>
<td>--</td>
<td>0.16*</td>
<td>0.30 (0.39)</td>
</tr>
<tr>
<td>Gender</td>
<td>0.04</td>
<td>0.06</td>
<td>0.02</td>
<td>0.01</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>0.62 (0.60)</td>
<td>0.61 (0.57)</td>
<td>0.57 (0.58)</td>
<td>0.58 (0.59)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.*** p < 0.001, ** p < 0.01, * p < 0.05. Zero-order correlation coefficients for intervention group are shown above the diagonal, and zero-order correlations for the control group are shown below the diagonal. Correlations are computed for average scale scores at each time point. T1 = baseline; T2 = 3-month follow-up; T3 = 6-month follow-up; T4 = 12-month follow-up. Gender was coded 1 = Men, 2 = Women.
Table 3. Linear Mixed Effect Model Results for Hostility

<table>
<thead>
<tr>
<th>Variable</th>
<th>$b$</th>
<th>S. E.</th>
<th>Cohen’s $d$</th>
<th>$b$</th>
<th>S. E.</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td></td>
<td></td>
<td>Adjusted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.63</td>
<td>0.02</td>
<td>1.31</td>
<td>0.09</td>
<td>0.09</td>
<td>0.28</td>
</tr>
<tr>
<td>Intervention Group at Baseline</td>
<td>0.04</td>
<td>0.03</td>
<td>0.08</td>
<td>0.03</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>Time effect – 3 months$^a$</td>
<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.11</td>
</tr>
<tr>
<td>Time effect – 6 months$^a$</td>
<td>-0.01</td>
<td>0.03</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td>Time effect – 12 months$^a$</td>
<td>-0.06</td>
<td>0.03</td>
<td>-0.12</td>
<td>0.02</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Intervention group – 3 months$^b$</td>
<td>-0.20***</td>
<td>0.04</td>
<td>-0.43</td>
<td>-0.06</td>
<td>0.04</td>
<td>-0.18</td>
</tr>
<tr>
<td>Intervention group – 6 months$^b$</td>
<td>-0.27***</td>
<td>0.04</td>
<td>-0.57</td>
<td>-0.09*</td>
<td>0.04</td>
<td>-0.28</td>
</tr>
<tr>
<td>Intervention group – 12 months$^b$</td>
<td>-0.28***</td>
<td>0.05</td>
<td>-0.59</td>
<td>-0.09*</td>
<td>0.04</td>
<td>-0.26</td>
</tr>
</tbody>
</table>

Note. $^a$ Within group comparisons i.e., results compared to baseline; $^b$ Between group comparisons, i.e., the intervention group and the control group compared at each time point (3, 6, 12 months) – these effects are obtain through an interaction term between time point and group allocation; In the adjusted model, the intercept is not interpretable. * $p < .05$, ** $p < .01$, *** $p < .001$. 
Figure 1. CONSORT Diagram

Individuals who legally divorced in Denmark January 1st 2016 - 31st December 2017
(n = 47,251)

Study invitations sent with divorce decree by the Danish State Administration
(n=?) (data unattainable)

Baseline Questionnaire (n=1,882)

Randomized (n=1,882)

Intervention Group (n=1,050)

3-month follow up (n=293)
Lost to non-response (n=757)

6-month follow up (n=254)
Lost to non-response (n=796)

12-month follow up (n=230)
Lost to non-response (n=820)

Analyzed (n=1,031)
Excluded from analysis:
Did not report gender (n=4)
Married less than one day (n=15)
Married same year as born (n=0)

Control Group (n=832)

3-month follow up (n=248)
Lost to non-response (n=584)

6-month follow up (n=212)
Lost to non-response (n=620)

12-month follow up (n=190)
Lost to non-response (n=642)

Analyzed (n=825)
Excluded from analysis:
Did not report gender (n=1)
Married less than one day (n=5)
Married same year as born (n=1)

Combined Analyzed (n=1,856)
Figure 2. Hostility Means over Time as Estimated by the Unadjusted Mixed Linear Effect Model

Note. Time Point 1 = baseline; Time Point 2 = 3-month follow-up; Time Point 3 = 6-month follow-up; Time Point 4 = 12-month follow-up.
Figure 3. Average Hostility Scores of the Intervention and Control Groups at the 12-month Follow-up compared with National Norm Data

- Men: $p = .022, d = .350$
- Women: $p = .007, d = -.311$
- Control Group: $p < .001, d = .420$
- General Population Norms
- Intervention Group
- Control Group
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**Supplemental Material**

Supplemental Material Hostility - submitted.docx
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Supplemental Material
Consort Checklist_Hostility.doc