




# The Dating and Domestic Violence App Rubric: Synthesizing Clinical Best Practices and Digital Health App Standards for Relationship Violence Prevention Smartphone Apps

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## ABSTRACT

Smartphones are used to both perpetrate and intervene in dating and domestic violence (DV). However, existing DV literature primarily evaluates technology as a tool for perpetration and emerging frameworks that measure eHealth app interventions have not yet considered DV.

To address this gap, the Dating and Domestic Violence App Rubric assesses smartphone-based DV intervention apps along common eHealth app measures such as user responsiveness and security as well as DV-appropriateness – categories derived from eHealth intervention theory and evidence-based DV interventions. As proof of concept, 38 DV intervention apps for iPhone were measured using this rubric.

K-means cluster analysis identified three clusters (high, medium, low). Apps targeting specific users or a specific intervention strategy tended to score higher overall. Findings suggest high-quality DV intervention apps may depend on active collaboration between stakeholders including app developers, DV advocates, and other professionals. Future research should expand this research to include additional DV apps and explore how individuals use smartphone apps to prevent or intervene in DV.

## 1. Introduction

In the early 2000s, as digital technology became increasingly common in public life, advocates and researchers began to explore its effect on dating and domestic violence (DV) (National Network to End Domestic Violence | Safety Net Project, n.d.). At about the same time, researchers began formal investigation into stalking perpetrators' use of technology including the use of video cameras, spyware, and GPS to monitor and harass victims (Southworth, Finn, Dawson, Fraser, & Tucker, 2007; Spitzberg & Hoobler, 2002). This led to investigations of how technology could be used specifically to harass intimate partners as well (Southworth & Tucker, 2007; Southworth, Finn, Dawson, Fraser, & Tucker, 2007).

As the problem of dating violence became a greater public concern, Liz Clairborne Inc. sponsored the first study at the intersection of technology and adolescent dating violence (Picard, 2007). This launched advocacy and research efforts that found as many as one in four adolescents had been harassed or harmed by a dating partner using technology (Associated Press/MTV, 2009; Picard, 2007).

Unfortunately research on technology and relationship violence has typically focused on technology as a tool for abuse. Conversely, research on domestic and dating violence interventions typically examine the efficacy of non-digital interventions promoted and moderated by in-person advocates, teachers, or other helping professionals (De Koker, Mathews, Zuch, Bastien,

& Mason-Jones, 2014; Hinduja & Patchin, 2011; Wolfe, Crooks, & Jaffe, 2009). Yet mobile technology, including the Internet, mobile apps, and apps for Internet browsers, dramatically expands the possible range of intervention options available for many physical and mental health concerns, including domestic and dating violence (Merolli, Gray, & Martin-Sanchez, 2014; VanHemert, 2015).

In the last several years, researchers have begun to explore digital interventions for dating and DV. Their studies primarily examine the features and performance of individual apps and range from provider-focused hospital screening and referral systems for intimate partner violence to victim-focused apps designed to help individuals threatened or victimized by dating or DV. These include provider-facing apps in hospitals (Choo et al., 2015; Feder et al., 2011), modular, web-based victim safety tools (Eden et al., 2015; Hegarty et al., 2015) and the evaluation of individual smartphone app-based interventions (Glass et al., 2015; Richman, Webb, Brinkley, & Martin, 2014). Yet, these interventions have not been evaluated collectively. Several of the apps included in this review have been the subjects of independent research which have found them to be safe, reliable, and effective in responding to dating and DV or increasing victims' sense of safety or autonomy (Eden, 2015; Glass et al., 2015). This is consistent with recent findings regarding digital interventions for intimate partner violence that suggest that digital technology may effectively facilitate and even expand the intervention services

offered to victims by professional advocates (Hassija and Gray, 2011). Yet, very little evaluation of smartphone apps has been undertaken to date relative to the number freely available in smartphone app stores. This review begins to address this gap in the literature by collectively assessing the quality and potential of smartphone apps intended to intervene in intimate partner violence.

### **1.1. Models for ehealth app evaluation**

No previously published literature specifically focuses on evaluating domestic- and dating-violence specific apps; to fill this gap, effective evaluation criteria can be developed from existing literature that evaluates app-based interventions for individuals at risk of compromised physical, mental or emotional health. These models for evaluation typically target elements of (1) the intervention's technical design, (2) the intervention's conceptual or behavioral goals, or (3) both.

The technical approach assesses the various mechanisms underlying health interventions facilitated by mobile technology including text messaging, discussion forums, and app-based interventions which may occur singly or in combination (Danaher, Brendryen, Seeley, Tyler, & Woolley, 2015). This technical approach illustrates intervention pathways associated with these mechanisms using step-by-step procedures, exploratory or hierarchical intervention pathways, and other means (Danaher et al., 2015). On the other hand, the behavioral approach suggests a conceptual rationale behind the effectiveness of these interventions in engaging users and helping them modify their behavior (Oinas-Kukkonen, 2013). This approach illustrates the step-by-step behavioral change or psychological rationale associated with these interventions. For example, Merolli et al. (2014) suggest users may engage with social media as an effective management tool for chronic pain because they derive positive personal benefit from the act of engagement itself (Merolli, 2014). Researchers who consider both technical and behavioral elements in classifying the function and effect of technology-facilitated interventions have developed multidimensional models for evaluating app-based health and behavioral interventions. Two key models are particularly relevant in this discussion.

The first of these models was designed by Luxton (2011) to evaluate apps administered by professionals, such as health-care providers. Luxton evaluated apps along three foundational guidelines: usability, safety, and quality standards (Luxton, 2011). Usability comprises an app's adaptability to its end-user and the appropriateness of an app's intervention to its audience or the problem it is intended to address. App safety consisted of features such as passcodes (to the device, app or both), backup plans if the app fails to either technically or functionally help high-risk patients and user awareness of what personally identifiable information is sold or not kept secure by app creators. Because no formal quality standards exist for the development of app-based interventions, Luxton argued that the evidence base on which the app was developed should be published or made available to users.

The second key model, proposed by Jones et al. (2014), applied the technical and behavioral factors established by Google's company philosophy to the effective development of apps that provide

interventions for mental health concerns. Because this model reveals similarities between tech development and best practices in mental and behavioral health intervention, it is of critical importance when considering effective, meaningful evaluation strategies for app-based interventions for dating and DV. As discussed by Jones and her colleagues, both tech development and best practices in mental health intervention emphasize the importance of any intervention's adaptability to the needs of individual users or clients (Johnson, 2014; Jones et al., 2014; Ruehlman, Karoly, & Enders, 2012). Additionally, Jones and her colleagues advocate user agency in choosing and implementing the digital intervention best suited to their needs. This is also reflected in several points of the Google company philosophy and best practices in mental health literature for client-centered practice (Jones et al., 2014; Law, Baptiste, & Mills, 1995; Murphy, Duggan, & Joseph, 2013). Jones and her colleagues argue for a focused, clearly delineated scope of intervention as reflected in both the Google company philosophy and the literature on effective mental health practice (Draucker & Martsof, 2010; Jones et al., 2014). The authors synthesize these similarities to propose that both the technical and conceptual or behavioral aspects of app-based interventions for mental health concerns should be evaluated using these guidelines (Jones et al., 2014).

### **1.2. Requirements for apps focused on dating and domestic violence**

Apps intended to intervene in dating and DV should address the safety of users threatened with violence from a dating or domestic partner. This concern for app users was addressed in Luxton's 2011 model, which suggested that app-based interventions should focus on the unique considerations of its target population, and is particularly acute for victims of dating and DV. For example, smartphone app developers must be aware that the partner may have regular access to the user's (victim's) phone, the app may be used as a tool or tactic to harm the user/victim. Thus, in addition to Luxton and Jones' criteria, assessments of app-based interventions for dating and DV should include criteria addressing safety and the unique physical and digital dangers posed by the app-based interventions themselves to users who are victims of dating and DV.

Smartphone app-based interventions are becoming increasingly common (Choo et al., 2015; Eden et al., 2015; Glass et al., 2017). They are distinct from traditional interventions. External advocates or authority figures are neither needed to facilitate the use of smartphone apps nor moderate and provide direct services, and apps are available on-demand at the user's desired location and timing. Moreover, concerns about data security and privacy of personal information differ between information shared with a mobile app and information shared with an advocate.

A next step in understanding technology as an intervention for dating and DV includes understanding and measuring the merits of apps targeted at supporting individuals affected.

### **1.3. Present review**

The following review highlights the features and promise of smartphone apps developed for prevention, education, and crisis intervention efforts surrounding dating and DV. For

the purposes of this review, dating and DV are defined as relationship violence between individuals in a dating, cohabiting, or marital relationship. The apps examined in this review all have a stated purpose preventing or intervening in dating and/or DV and were available on the Apple App Store as of January 2017. The apps were assessed for salient features and compared along dimensions of user focus, quality of services provided and the evidence base of the intervention. The following sections describe the apps selected for review and the results of the assessment. This article concludes with a discussion of the future of such smartphone apps and suggested research on their efficacy.

## 2. Methods

### 2.1. App selection and inclusion

Apps included in this review had a specific focus on prevention or intervention for victims or potential victims of dating or DV. For apps designed to address multiple issues, the dating or DV intervention was discrete from the other interventions and consisted of more than a single phone number. Apps were included in this review only if they were in English, free of charge, and available from the Apple App Store in the USA. For consistency of evaluation, apps available only on Google Play and not in the Apple App Store were excluded from this review. App function and appearance are comparable across all iPhone screens and models, whereas Android apps' functionality and appearance vary depending on the phone manufacturer and operating system installed ("Supporting Different Devices | Android Developers," n.d.). For this reason, a single iOS rating was deemed feasible, where a single Android rating was not. Apps were excluded from this review if they did not include dating and DV intervention or prevention materials, even if they focused on sexual assault, human trafficking, resources for parents or other adults, child abuse, or cyberbullying, although the authors acknowledge these issues are related to such violence (Vézina & Hébert, 2007). Criteria were assessed by downloading and evaluating each app.

Potential apps were identified through an iterative keyword search process within the iOS App Store. Search terms used included "adolescent dating violence," "teen dating violence," "adolescent dating violence," "abuse," "teen abuse," "dating abuse," "DV," "domestic abuse," and "partner violence." The complete contents of each search result were screened for appropriate apps. App stores typically recommend four or five "related apps" when a given app is selected; these apps were also screened for inclusion. When the resultant list was crosschecked with apps cataloged by the Tech Safety Center at the National Network to End Domestic Violence (NNEDV), two additional apps were added. Apps that qualified for inclusion were downloaded onto a smartphone with an iOS operating system.

### 2.2. App rating system

Apps were assessed on a 27-point scale using the Dating and DV App Rubric created by the first author. Due to the nascent state of the literature on technology as a tool for intervention in dating and DV, preliminary criteria for the Dating and

Domestic Violence App Rubric were adapted from the distillation of principles used for evaluation of app-based interventions for other mental, behavioral, and physical health concerns. The major rubric categories (User Focus, App Core, Speed, Collaboration and Quality) were distilled from evaluation criteria common to both Luxton et al. (2011) and Jones et al. (2014).

The first four criteria in the rubric (user responsiveness, non-traditional users, focus and innovation speed) were adapted directly from these sources and applied to an intended app user base of victims of dating and DV. The final five criteria (provider-provider collaboration, provider-user collaboration, client expert, evidence base, and technical quality) were developed from principles present in either Luxton's or Jones et al.'s evaluation systems and are central to best practice in dating and DV intervention (Bybee & Sullivan, 2002; Kennedy et al., 2012). All items were specified to address either technical or conceptual components of the intervention, reflecting these and other evaluation criteria (D. C. Mohr, Schueller, Montague, Burns, & Rashidi, 2014; Oinas-Kukkonen, 2013; Wang et al., 2014).

The National Network to End Domestic Violence's Tech Safety Center publishes a guide to dating and DV apps that assess the degree of victim safety associated with each app (Olsen, 2017). While this rating does not denote security or safety, these assessments may be valuable to advocates and researchers. Thus, in this review, apps evaluated by NNEDV are highlighted with an asterisk (\*) in Table 2. Particular attention is recommended to this asterisk and the "client expert" and "evidence base" criteria, as these are particularly salient when considering safety and best practices.

In developing the Dating and Domestic Violence App Rubric rating scale, an app in each category could receive up to three points of weight for demonstrable significance in Luxton's evaluation criteria, Jones et al.'s criteria, and dating and DV advocacy and intervention. As a result, an app could receive a maximum of six points in the first two categories (User Focus, App Focus) and nine points in the second two categories (Collaboration, Quality). As an independent measure, Speed was considered to minimally impact the technical or advocacy quality of service delivery; moreover, scaling this binary response was considered to risk overshadowing other measures of service delivery. For this reason, the category of Speed received a single point of weight. Category points were dispersed among criteria within that category. In the case of the category of Quality, items related to evidence base and the safety of user data were considered to be of higher importance than the executed quality of the user interface; this was reflected in the lower total possible point value assigned to that dimension of technical quality. The final version of the Dating and Domestic Violence App Rubric is presented in Table 1.

Each app was independently assessed by two raters, one with expertise in DV advocacy and one with expertise in software development. All apps were rated by both raters and disagreements were resolved by consensus.

### 2.3. Data analysis

Ratings were analyzed using K-means cluster analysis. The number of clusters (K) was determined via minimizing the

Table 1. Dating and domestic violence app rubric.

	App name:			Total:/27
User responsive-ness	<b>User focus: Focus on the user</b> <b>3</b> High content customization based on user input (e.g. location, level of services needed, etc.) for all key intervention components. Users are fully able to reach out to personalized supportive networks or express concerns in-app or both.	<b>2</b> Moderate content customization based on user input for some key intervention components. Apps at this level will likely allow users to reach out to friends or peers, or voice some specific concern in-app, maybe not quite as flexibly as the user might want for the app's intended function.	<b>1</b> Low content customization based on user input: Some customization for specific user groups, though customization may be sparse or low-quality	<b>0</b> No content customization based on user input: Intervention identical for all users at all times
Users: non-traditional	Easy to access app's intended intervention for non-traditional users within target population (eg., LGBT, male victims)	App's intended intervention provided for non-traditional users within target population	Non-token interventions for non-traditional users within target population addressed, may be difficult to access; intervention (e.g. resources, may not actually be provided)	App's intended intervention not provided to non-traditional users; non-tradition users not acknowledged
Focus	<b>App core: It's best to do one thing really, really well</b> <b>6</b> All app components serve one central mission	<b>4</b> Central mission generally served; app may overreach or lapse in focus	<b>2</b> Some main idea(s); severe overreach or too many goals attempted	<b>0</b> App tries to accomplish too many things, focus is entirely lost
Speed	<b>Speed: Fast is better than slow</b> <b>3</b> N/A	<b>2</b> N/A	<b>1</b> Digital intervention operates faster than the service it is trying to replace	<b>0</b> Digital intervention NOT faster than the service it is trying to replace (eg., a paper pamphlet could convey an identical intervention)
Provider-provider	<b>Collaboration: Democracy on the web works</b> <b>3</b> App design appropriate for the intervention. Eg., a) Reading level (verbiage, quantity of text on page, spacing, tone) is appropriate for audience. b) Any crisis-response features intuitive, large and easy to access within the first layer of intervention. c) Any information components come with quizzes or case-study modules. d) Navigation (such as back buttons, or hidden/side panels) straightforward and intuitive	<b>2</b> App design generally appropriate for the intervention. Eg., a) Reading level (verbiage, quantity of text on page, spacing, tone) generally appropriate for audience. b) Any crisis-response features somewhat easy to access within the first layer of intervention c) Any information components clear and accessible. d) Not straightforward navigation; easy to figure out	<b>1</b> App design somewhat appropriate for the intervention. Eg., a) Reading level (verbiage, quantity of text on page, spacing, tone) sometimes appropriate to audience. b) Any crisis-response features large and fairly easy to access (first two layers of intervention). c) Any information components generally clear and accessible. d) Navigation (such as back buttons, or hidden/side panels) clunky or very unintuitive	<b>0</b> App design not appropriate for the intervention. Eg., a) Reading level (verbiage, quantity of text on page, spacing, tone) not appropriate to audience. b) Any crisis-response features are either not large or difficult to access c) Any information components are not clear or accessible. d) Navigation almost unusable; can be easier to exit app and relaunch
Provider-user	App built around user/professional or moderated user/user collaboration. Context provided to user, recommendations may be based on user characteristics	User/professional (or moderated user/user) interaction possible, easy to access, may be linked in generic directory or simple list form. No context provided.	Professional/user interaction difficult; contact numbers hard to find	Platform does NOT allow professional/user interaction; numbers may be in app but not callable
Client expert	<b>Client expert on own situation – app allows client to come with the problem; does not make blanket assumptions about client or client needs. Has a variety of possible intervention pathways (resources, interactive features, etc.). Copy (wording) is fully agentic and non-judgmental</b>	<b>Client perspective invited; likely to have a variety of resources or hotline numbers, and may have quizzes with accessible questions and results. Copy may not be fully agentic, but is non-judgmental. But intervention procedure is slightly forced, or “app is expert”</b>	<b>Client perspective acknowledged; may have a variety of resources or hotline numbers or vague/low-accessibility interactive elements. Copy may not be at all agentic, often succeeds at being non- judgmental. Pigeonholes client perspective – “app fully knows best”</b>	<b>No space for client perspective.</b>
Evidence grounding	<b>Quality standards</b> <b>3</b> <b>Intervention based on evidence-informed practice. Source is referenced or cited somewhere in app.</b>	<b>2</b> <b>Academic evidence partially incorporated into intervention. Source is acknowledged in-app.</b>	<b>1</b> <b>Evidence-informed practice acknowledged by intervention, source may not be specifically acknowledged.</b>	<b>0</b> <b>Evidence-informed practice not acknowledged.</b>
Technical quality	N/A	Intuitive graphics and functionality; highly usable, native content; clear point of arrival. User feels oriented at all times when using the app.	Graphics, functionality easy to understand, not intuitive. User might reach local points of arrival, but still expect more; find themselves temporarily lost or disoriented.	Graphics, functionality not intuitive, difficult to figure out. User gets lost in sprawling app, or expecting non-existent functionality, or never reaching point of arrival.

**Table 2.** App rankings per the dating and domestic violence app rubric.

	Total Score (max 27)	User Focus			Speed (max 1)	Collaboration			Quality			NNEDV/advocacy quality
		User-responsive (max 3)	Users: non-traditional (max 3)	App core: Focus (max 6)		Provider-provider (max 3)	Provider-user (max 3)	Client expert (max 3)	Evidence base (max 3)	Technical quality (max 2)		
Circle of 6 U	26	3	3	6	1	3	2	3	3	2		
ASK	25	3	3	6	1	3	3	3	1	2	*	
Circle of 6	25	3	3	6	1	3	2	3	2	2	*	
Tech Safety	25	2	3	6	1	3	2	3	3	2	*	
Daisy	24	2	3	6	1	2	3	3	3	1		
Hestia/Bright Sky	24	3	2	6	1	2	3	3	3	1		
LiveFree	24	2	3	6	1	3	3	3	2	1		
One Love My Plan	24	3	2	6	1	3	3	2	3	1	*	
Over The Line	24	3	2	6	1	3	3	3	1	2		
Youth Pages	24	2	2	6	1	3	3	3	2	2		
One Love Lite	23	3	3	6	1	2	1	3	3	1	*	
TD 411	22	2	3	6	1	2	2	2	3	1	*	
TDVNYC	22	1	3	6	1	3	2	3	1	2		
B Safe	21	3	2	6	1	3	2	3	0	1	*	
RUSafe	21	3	2	6	1	2	3	3	1	0	*	
Aspire News	19	2	2	6	1	2	2	1	2	1	*	
myPlan	19	3	1	4	1	2	2	2	3	1		
Teen Hotlines	19	0	0	6	1	2	3	3	2	2		
R3	18	2	1	4	1	2	2	2	3	1	*	
Domestic Violence Preven-tion	17	0	1	6	1	2	2	1	3	1		
iHope Safety and Support	17	3	2	4	1	1	2	2	2	0		
PATH/H	17	1	2	6	1	1	3	1	1	1		
Self Help	17	0	2	6	0	2	0	3	3	1		
Peace	16	1	2	4	1	2	2	2	1	1		
Reduce the Risk	16	1	2	4	1	1	2	2	2	1		
DVI: Domestic Violence Inventory	14	2	0	6	1	1	2	1	0	1		
Positive Pathways	14	2	2	4	0	1	1	3	1	0		
RADAR-App	14	1	1	4	1	1	2	1	2	1		
Pevo	13	1	2	4	0	2	1	1	1	1		
Love Hurts?	11	1	0	6	1	1	0	1	1	0		
Choose to Stop	10	1	0	4	0	1	1	1	2	0		
DVP	10	0	0	6	0	1	0	0	3	0		
DASH	10	0	1	2	1	0	1	1	3	1		
Gwen Alert	6	2	2	0	0	0	0	1	0	1		
WIC	6	2	0	2	0	0	0	2	0	0		
SOS Connect	5	0	2	0	0	1	2	0	0	0		

Note: While an asterisk (\*) denotes a published NNEDV review of an app's security, neither the presence nor absence of an asterisk indicate that an app has adequate security measures in place. As a result, NNEDV ratings were not included in subsequent analyses.

model's Bayesian Information Criterion (a transformation of a model's maximum likelihood estimate that accounts for the total number of model parameters) and cluster means and variances were assessed. Maximum likelihood ratio tests were used to assess the significance of the model cluster distribution compared to a null cluster distribution. *T*-tests were used to assess significant differences between mean cluster ratings. Calculations were performed using the Sckit-Learn machine-learning library (version 0.18.1) in Python (version 2.7) and Stata (version 14.3).

### 3. Results

#### 3.1. App descriptions

Totally, 54 apps screened positive for a discrete focus on intervention or prevention of dating and/or DV. Two were excluded (SafeNight, SafeResponse) because they provided exclusively financial support to victims of DV, one was excluded (R U Safe?) because it was not available in the USA and 15 were excluded because they were only available on Android devices.

Of the 36 rated apps, 10 focused specifically on adolescent dating violence prevention or intervention, 15 focused

primarily on adult DV prevention and 11 included specific resources or support for both adolescents and adults. Totally, 23 apps were developed by US -based organizations, six were developed by Australian organizations, four were developed by organizations based in the UK and countries of origin of three apps were unclear.

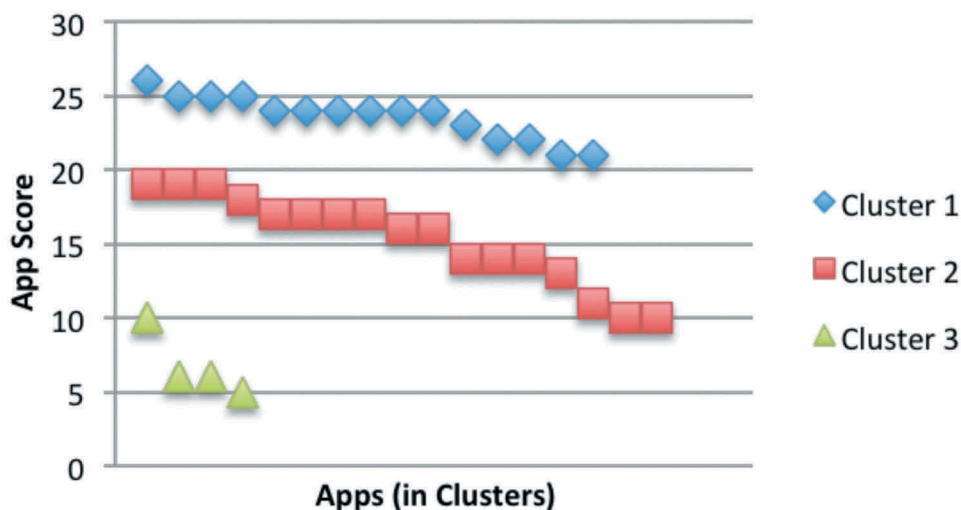
#### 3.2. App ratings

Table 2 presents a list of the apps studied and both cumulative and measure-specific ratings for each app. Apps marked with an asterisk (\*) in the last column have been publicly reviewed by the NNEDV. The categories Client Expert, Evidence Base, and NNEDV/Advocacy were considered to be of special significance to dating and DV safety and best practice.

As demonstrated in Table 2, each app was ranked independently on each of the nine rubric parameters shown in the table headings. The nine rankings of each app were used for cluster analyses. The minimum Bayesian Information Criterion indicated that the data were best represented by three clusters (Bayesian Information Criterion = 881.7). K-means analysis indicated how many and which apps should be sorted into each of the three predicted clusters. Figure 1 represents the 36 review apps sorted into these three clusters.

Cluster analyses were based on scores in each of the nine rubric parameters for each app. However, for ease of comprehension, a total score was determined for each app by summing its scores on the nine rubric parameters; cluster results are presented using the mean of those total scores for the apps within each cluster. The mean total scores of the three app clusters are 23.6 ( $n = 15$  apps; within-cluster  $sd = 1.41$ ; between-cluster  $sd = 0.01$ ), 15.35 ( $n = 17$  apps; within-cluster  $sd = 2.83$ , between-cluster  $sd = 0.03$ ), and 6.75 ( $n = 4$  apps; within-cluster  $sd = 1.73$ , between-cluster  $sd = 0.21$ ). These are represented in Figure 2.

A maximum likelihood ratio test compared the study model (maximum log likelihood estimate =  $-435.5$ ) to a corresponding randomly generated model (maximum log likelihood estimate =  $-519.9$ ). Both models had nine identically scaled parameters and three clusters. The maximum likelihood ratio test yielded a value of 168.8 with two degrees of freedom ( $p < 0.01$ ), indicating that the study model is dictated at a statistically significant level by app ratings on rubric criteria. Typically, K-means cluster analysis results in significantly different means between study model clusters; this was anticipated to be the case in the current analysis. Two-sample  $t$ -tests confirmed significant differences between each pair of model



Cluster 1		Cluster 2		Cluster 3	
App	Score	App	Score	App	Score
Circle of 6 U	26	myPlan	19	DASH	10
Tech Safety	25	Aspire News	19	Gwen	6
Circle of 6	25	Teen Hotlines	19	Alert	
ASK	25	R3	18	WIC	6
One Love My	24	Domestic Violence	17	SOS	5
Plan		Prevention		Connect	
Hestia / Bright	24	Self Help	17		
Sky		iHope Safety and	17		
Daisy	24	Support			
Youth Pages	24	PATH/H	17		
LiveFree	24	Reduce the Risk	16		
Over The Line	24	Peace	16		
One Love Lite	23	RADAR-App	14		
TD 411	22	Positive Pathways	14		
TDVNYC	22	DVI: Domestic	14		
RUSafe	21	Violence Inventory			
B Safe	21	Pevo	13		
		Love Hurts?	11		
		DVP	10		
		Choose to Stop	10		

Figure 1. App clusters by total score per the dating and domestic violence app rubric.

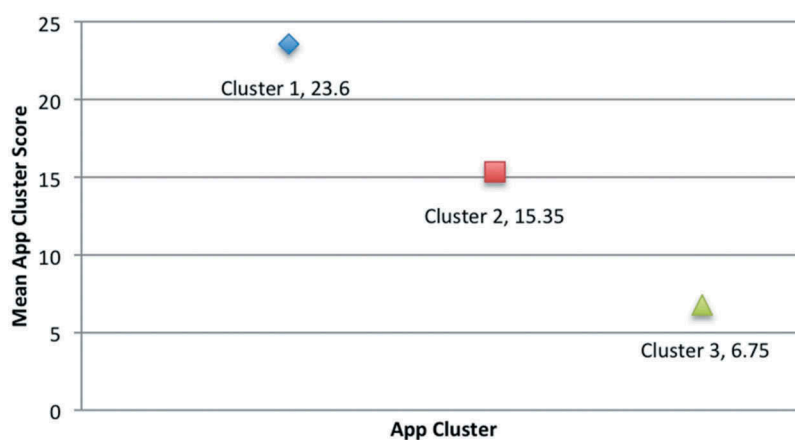


Figure 2. Mean app cluster score by cluster.

cluster means: Cluster 1 compared to Cluster 2 ( $t = 10.21$ ,  $p < 0.01$ ), Cluster 1 compared to Cluster 3 ( $t = 20.35$ ,  $p < 0.01$ ), and Cluster 2 compared to Cluster 3 ( $t = 5.76$ ,  $p < 0.01$ ).

## 4. Discussion

### 4.1. Overall app ratings

Apps in this review were assessed on nine dimensions that evaluated both their performance as apps and their performance as interventions for dating and DV. Cluster analyses suggested that the apps studied could be broken into three categories of overall quality. Four low-quality apps demonstrated difficulties both as apps and as interventions for dating and DV with an average total score of 6.75 out of the 27 points possible. Totally, 17 middle-quality apps demonstrated a wide range of strengths and challenges across the nine rubric measures, including their performance both as apps and interventions, with an average total score of 15.35 out of 27. The 15 highest quality apps also demonstrated a range of strengths and challenges but tended to score well across multiple rubric measures, both as apps and as interventions overall. Their average total score was 23.6 out of 27. The strengths and challenges of each of the 36 app-based interventions highlight considerations of efficacy, technical quality, security, and meaningfulness that will affect any efforts in this developing digital intervention space.

### 4.2. App usage

Due to the pervasiveness of smartphones and the availability of these apps in smartphone app libraries, the potential reach of app-based interventions for dating and DV is significantly broader than the potential reach of in-person interventions. Yet, many apps studied were difficult to find in the App Store. This limits their visibility and utility to prospective users. In addition, many apps were limited in their scope, providing intervention materials to only a narrow group of users (usually female individuals victimized by male perpetrators). This group includes Teen Hotlines or R3, whose potential

utility was compromised for victims whose needs did not fall within the narrow groups defined.

While the potential reach of app-based interventions may be substantially broader than in-person interventions, availability does not necessarily correlate with the number of times an intervention is downloaded or the number of times it is used. App-based and other eHealth interventions are likely to be most effective when used to supplement or facilitate (rather than replace) professional care, a concept known as supportive accountability (Luxton, McCann, Bush, Mishkind, & Reger, 2011; Mohr, Cuijpers, & Lehman, 2011). User attrition is one of the greatest challenges of health app development and supportive accountability expands both users' and providers' ability to access and administer care (Aguilera, 2015; Mohr et al., 2011). Frequently, this may be accomplished using smartphone-native strategies such as automated texts or push notifications (Aguilera, 2015). However, many of these strategies are likely to increase the danger of victims of dating and DV because they may be visible to the victim's abusive partner. Because of this, as with all interventions, strategies to encourage user – but not abuser – usage should be considered when designing app-based interventions for victims of dating and DV.

### 4.3. App efficacy

Further, an app's availability and successful user engagement strategies do not guarantee that the app is an effective intervention for dating or DV. Because smartphone apps do not undergo a formal vetting process before release, the health- or safety-related quality of their content is not guaranteed. The speed, collaboration, and democratization of knowledge made possible through the creation and release of smartphone apps increase the options available to consumers and form a key tenet of technological development (Jones et al., 2014). However, it also results in apps with a wide range of functional quality that, at face value, are indistinguishable from one another.

On one end of this spectrum are apps that offer supportive accountability – that is, they provide an interface between providers and users, and are not approached as a self-help tool. The importance of this is highlighted in Luxton's criteria for effective app-based interventions of all kinds and was

incorporated into the collaboration category of the Dating and Domestic Violence App Rubric (Luxton, 2011). Smartphone apps that offer collaboration through supportive accountability and other collaborative measures are used more frequently than other apps, and users tend to experience greater health benefits from their use (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012; D. Mohr et al., 2011). For the purposes of this review, apps that scored high on collaboration, such as LifeFree, ASK, and Youth Pages, may be hypothesized to provide more benefit to users than other apps.

At the other end of the spectrum are apps that do not work, or apps that are harmful to victims and survivors of dating and DV. In the current review, iHope and WIC were developed by individuals with no connection to advocacy services or evidence-based practice. Their interventions may include victim-blaming language and recommendations to seek couples counseling or anger management. These contradict evidence-based practice and commonly accepted best principles of dating and DV advocacy (Gondolf & Russell, 1986; The National Domestic Violence Hotline | Why We Don't Recommend Couples Counseling for Abusive Relationships, n.d.; Yawn, Yawn, & Uden, 1992). In order to avoid this risk, app consumers, especially those recommending apps to other potential users, must be meticulous about which apps they recommend.

#### **4.4. App security and technical quality**

Wide variability is also found in apps' technical quality. Unsurprisingly, apps with high technical quality ratings on the Dating and Domestic Violence Apps Rubric (Tech Safety, Over The Line, Youth Pages) are generally among the highest rated apps. These apps typically attend to data storage, management, and presentation, including accessible user interfaces, updated and functional links, app-native content (such as nested tabs and responsive interactive features), technical capabilities that are mindful of the safety of victims of dating and DV (such as the ability to turn off location tracking) and the safe and secure storage of user data by developers.

Technical and security-based risks to dating and DV victims can be found in apps that are developed at both high and low levels of sophistication. At high levels of sophistication, apps include elements of persuasive system design that may contribute to, or detract from, victim security. These may include push notifications, GPS location tracking, and more (Danaher et al., 2015; Hamari, Koivisto, & Pakkanen, 2014; Kelders et al., 2012). Because of the perpetrator's typical proximity to the victim, such features may place the victim at increased risk of harm if the perpetrator tracks, has access to, or can simply view the lock screen of the victim's phone. For this reason, app features such as passwords, hidden panels, no-cost accessibility and the user's ability to disable push notifications, location access, and other features are critically important.

Apps that are developed at a low level of sophistication – or apps that are developed at a high level of sophistication but are not well maintained – experience a lack of regular updates and poor data storage. Most dating and DV apps are not regularly updated (Olsen, 2017). Apps included in this review often contain links to outside sources (such as hotlines or

advocacy resources) and apps that are not updated have a higher susceptibility to broken links and outdated information. In addition, smartphone industry norms predict regular hardware updates and frequent software updates; these may change the display of user interfaces programmed prior to the update and the nature of interfaces with which users expect to interact. As a result, apps that are not regularly updated may experience flaws in their display and outdated interfaces that may no longer be natural to users. These issues affect apps (such as Daisy and Over the Line) that in all other ways are considered high quality by this review.

Outdated or inadequate technology may contribute to or worsen security loopholes and liabilities for the user data stored by a given app. This places victims of dating and DV at particular risk of increased harm. Even among apps that are regularly updated, many still experience security concerns because app developers do not store user data with adequate security provisions. When this happens, user information can be accessed externally and user privacy is violated. When identifying user information is accessible through an app developer's inadequately secured database, perpetrators of dating and DV may gain access to victim information. This may include the victim's name, contact information, current location, the help they are seeking, safety measures they plan to take and disclosures about the nature of the violent relationship. These potential security breaches pose extreme risks to victims, typically without their knowledge. Lack of secure data storage is a liability for many apps in the present review; one app (SOS Connect) not only fails to secure victim information on its database, it makes user information visible to other users within the app itself. When a victim of dating or DV uses this app, the perpetrator only needs to download the app to see what information the victim has shared in their help-seeking process. In part, the NNEDV Tech Safety Center was formed in response to these risks, and security of information forms a critical part of their app evaluations (marked with an asterisk in Table 2).

#### **4.5. Appropriateness of apps as an intervention for dating and domestic violence**

Before being applied as an intervention to a given problem, developers should determine that a digital intervention is appropriate to individual users, their social context, the psychological and behavioral outcomes that are being pursued and the logic model or theory of change of the corresponding non-digital intervention (Cugelman, 2013). This level of detail is useful in considering whether or not dating and DV are good candidates for app-based intervention.

In this review, these considerations are reflected in the User Focus, App Core, and Speed categories of the Dating and Domestic Violence Apps Rubric. The ratings demonstrate each app's awareness of and adherence to its users ("User responsiveness"), its users' social context ("Non-traditional users") and the theory of change it employs with respect to dating and DV intervention ("Focus" and "Evidence base").

Effective app-based interventions for victims of dating and DV will consider barriers to safety as well as the social and contextual factors underlying those barriers. Many apps in



this review, such as Circle of 6 and Circle of 6 U, LiveFree and Youth Pages, demonstrated clear awareness of their users, their users' context, the desired outcomes of the intervention and the appropriateness of their theory of change to an app-based platform. As such, these interventions may be considered particularly appropriate for app-based intervention. The execution of other apps in this review, such as Dash and Reduce the Risk, offered above-average technical and evidence-based interventions but struggled to show awareness of their users, their users' social context or the relevance of an app-based platform to the theory of change underlying the specific desired intervention outcome. As a result, an app-based format may not be the most appropriate for these interventions as currently constructed.

#### 4.6. Limitations and future directions

This review faced several limitations. While ratings using the Dating and Domestic Violence App Rubric were established by consensus using multiple raters from multiple vantage points of expertise, the rubric was not tested for interrater reliability. Due to the potential utility of establishing a standard of quality for smartphone apps developed as interventions in dating and DV, future research should further test and develop this rubric, including assessments of interrater reliability. Rating and reliability by more than two raters would also contribute to the improvement of this evaluation metric.

Additionally, while K-means cluster analysis was useful in partitioning the apps studied into appropriate categories of high, middle, and low quality, this analysis is typically performed on significantly larger sample sizes. As a result, future research should include additional DV intervention apps. In the present study, while cluster means were based on input from each of the nine rubric parameters, nuanced analysis of app allocation along each rubric parameter could not be assessed given the relatively small sample size and analysis performed. Future research should build on the baseline established with the iPhone apps in this review by including additional apps such as paid apps and those available on Android's Google Play.

The most critical direction for future research involves assessment of the extent to which these apps are valuable to users. Some apps have been tested individually for effectiveness in responding to dating and DV, most have not (Eden et al., 2015; Glass et al., 2015). In addition, little evidence exists to suggest whether smartphone apps are a productive or welcome intervention for victims of dating and DV. Future research may investigate the extent to which users' experiences support this use. For example, research may include work with app developers to investigate the extent to which app-based interventions connect users to supportive services. Meaningful research into apps' utility for users will necessarily involve an exploration of users' subjective experiences. This may include whether these apps provided users with a heightened sense of safety or increased access to resources. Such research will also include examining barriers to the use of these interventions, whether technical (such as difficulty understanding the app), personal (such as

lack of interest in its continued use), or logistical (such as phone tracking by an abusive partner). This research will be foundationally meaningful in guiding the way developers, advocates, and researchers approach, advocate, and disseminate app-based interventions to dating and DV in the future.

## 5. Conclusion

The apps included in this review provide extensive and wide-ranging technology-based services to victims of dating and DV. The challenges facing researchers and advocates are not creating these supportive resources but assuring their quality and usability by victims. As an initial step, the Dating and Domestic Violence App Rubric was created to describe the variation in quality of existing smartphone-based apps intended to intervene in dating and DV. Further development of this rubric, as well as research with users and potential users, should determine where, when, and how individuals use smartphone-based apps to prevent or intervene in dating or DV. Such research may change the scope and widely expand the availability of technology-based adolescent dating and DV interventions.

*Note: Underlying research materials will be provided by the first author upon request.*

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