The Avatar Will See You Now:

Support from a Virtual Human Provides Socio-Emotional Benefits

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Abstract

When people are in emotional distress, they often seek support. Virtual humans may provide unique and complementary benefits to human support provision, given that virtual humans are readily available and help sharers overcome socio-evaluative threats, thereby increasing willingness to disclose. Here, we examined whether talking to a virtual human elicits socio-emotional benefits, and whether this is moderated by the type of support provided. To examine the scope of the potential effect, we compared two key types of support (emotional and cognitive), across two emotions (anger and worry). Participants ($N = 115$) shared two personal emotional experiences with a virtual human, who provided either emotional or cognitive support via the Wizard-of-Oz method (i.e., a human-operated avatar). Results showed that participants felt better after talking to the virtual human, as evidenced by reduced intensity of the target emotion and generally improved affect. The emotional improvement was similar for emotional and cognitive support. Cognitive support was also experienced as equally effective as emotional support, and led to similar levels of experienced closeness and desire to interact with the virtual human again. These findings suggest that talking to a virtual human can be a valuable form of support at times of distress.

Keywords: Virtual Human, Interpersonal Emotion Regulation, Social Support, Emotional Support, Cognitive Support, Computer-Human Interaction

Highlights

- Sharing negative emotions with a virtual human reduces negative emotions
- Sharing with a virtual human fosters emotional relief, regardless of support type
- Virtual humans may help overcome sharers' resistance to cognitive support

1. Introduction

When people are in emotional distress, they often turn to others for support, a phenomenon that has been termed social sharing (Rimé, 2009; Rimé et al., 1998). Social sharing is frequently employed as a means of regulating one's emotions: By talking to others, sharers can elicit support that might facilitate their coping (Rimé, 2009). Unfortunately, however, people do not always feel comfortable sharing their personal problems with others, for example when these concern highly stigmatized issues (Smart & Wegner, 2000). Moreover, people do not always have someone to talk to: Friends may have grown tired of listening to the same problems over and over again (Forest et al., 2014) and professional help can be too expensive, located too far away, or come with a long waiting list (Hunt & Eisenberg, 2010; Johnson et al., 2007). In light of these problems, we examined whether talking to a virtual human may bring about emotional relief and thereby constitute a valuable form of support.

Recently, both public and scientific interest in virtual humans' potential to complement traditional mental healthcare is growing (Markoff & Mozur, 2015; Romeo, 2016). Virtual humans are computer-generated characters that respond to words and non-verbal behavior in human-like ways, using emotional expressions, language, and body language (Gratch et al., 2002), and they can provide forms of support that are readily accessible to anyone with an internet connection. Recent work has shown that people are willing to disclose upsetting situations to virtual humans, sometimes even to a greater extent than when sharing with a human (Gratch et al., 2014; Lucas et al., 2014, 2017). It is unclear, however, whether talking to a virtual human is indeed effective in bringing about emotional relief, and to what extent this is dependent on the type of support that is provided.

Two primary types of support have been distinguished: emotional and cognitive (Rimé, 2009). Emotional support includes comfort, validation, and understanding, and is

typically associated with short-term relief and perceived helpfulness, as well as more relational closeness (Batenburg & Das, 2014; Morelli et al., 2015; Nils & Rimé, 2012; Pauw, Sauter, van Kleef, et al., 2018). Cognitive support, on the other hand, is directed at changing the way the other thinks about the emotional situation by recreating meaning and reappraisal, and is associated with more long-term emotional recovery (Batenburg & Das, 2014; Nils & Rimé, 2012). In the present study, we compared the effect of emotional vs. cognitive support on various socio-emotional outcomes.

1.1 Sharing with Virtual Humans

To effectively reduce people's experience of negative emotions, those sharing their emotions – henceforth 'sharers' – need to be willing to talk about the emotions elicited by an emotionally upsetting event (Burleson & Goldsmith, 1996; Greenberg, 2004; Rimé, 2009). However, openly disclosing one's emotions may also signal vulnerability, which puts the sharer at risk of being ridiculed, rejected, or stigmatized (Burleson & Goldsmith, 1996; Derks et al., 2008). Thus, in order for people to be willing to share and discuss sensitive issues, a safe and non-threatening conversational environment is required (Burleson & Goldsmith, 1996; Greenberg, 2004).

Virtual humans can provide such a safe environment, as they offer the best of both worlds: They are capable of establishing an emotional connection while also fostering anonymity. Unlike when talking to humans, talking to a computer does not evoke socio-evaluative concerns and thereby nullifies any risks related to negative self-presentation (Caplan & Turner, 2007). At the same time, virtual humans are capable of creating rapport, and can reduce tension and embarrassment by using both verbal (e.g., empathic responding, reciprocal self-disclosure) and non-verbal behaviors (e.g., smiles, encouraging head nods; Bickmore & Picard, 2005; Birnbaum et al., 2016a, 2016b; Gratch et al., 2013; Hoffman et al., 2014; Kang et al., 2008; Liu & Sundar, 2018; Wang & Gratch, 2010). Supporting virtual

humans' potential as conversational partners, several studies have shown that participants who believed they were interacting with a computer reported lower fear of self-disclosure and lower impression management, and were rated by observers as more willing to disclose, compared to those who believed they were interacting with a human-operated computer (Gratch et al., 2014; Lucas et al., 2014, 2017).

Furthermore, while we know very little about interacting with virtual humans, recent work suggests that talking to other types of conversational agents (particularly chatbots) has potential for bringing about socio-emotional benefits. For example, in the last decade, a wide variety of chatbot interventions have been developed that overall seem to be relatively effective in reducing psychopathological symptoms, including stress, depression and anxiety (Bendig et al., 2019; Fitzpatrick et al., 2017; Hoermann et al., 2017; Inkster et al., 2018; Ly et al., 2017). Furthermore, studies investigating mental health interventions delivered by social robots have shown that people experienced a positive increase in mood after talking to a social robot, though it should be noted that these studies included small samples (mostly elderly) and suboptimal measures of emotional experience (e.g., observations by caregivers or self-reported improvement in hindsight; for a review, see Scoglio et al., 2019). Finally, in terms of health more broadly, recent meta-analyses show that virtual human interventions have an overall positive effect on health-related outcomes like health-promoting attitudes and behaviors (Chattopadhyay et al., 2020; Ma et al., 2019).

Thus, while some of this work speaks to the potential of conversational agents for improving socio-emotional outcomes, it has often examined wellbeing broadly defined, and to our knowledge, has not examined whether emotions in response to the disclosed emotional stressor decrease after talking to a virtual human. Consequently, it remains unclear to what extent interacting with virtual humans may bring about emotional relief, and what the active

ingredients are if it does. One key element may be the type of support provided by virtual humans.

1.2 The Role of Support Type

The way in which listeners respond to emotional self-disclosure matters. Two main forms of support are employed for downregulating others' negative emotions : emotional and cognitive (Rimé, 2009). Emotional support includes comfort and validation, and increases the sharer's temporary feelings of relief, perceived understanding, and closeness to the listener (Batenburg & Das, 2014; Morelli et al., 2015; Nils & Rimé, 2012; Pauw, Sauter, van Kleef, et al., 2018). Furthermore, experiences of negative emotion tend to be shorter when they are shared with a partner who provides emotional support (Brans et al., 2013). These findings speak to the critical role of emotional support in fostering perceived responsiveness, which refers to the confidence that the other will understand, accept, and be responsive to one's needs, and which lies at the core of emotional and relational wellbeing (for overviews, see Reis et al., 2017; Reis & Gable, 2015).

Cognitive support, on the other hand, is generally more conducive to bringing about long-term emotional recovery (Batenburg & Das, 2014; Lepore et al., 2004; Nils & Rimé, 2012; Rimé, 2009). By helping the sharer take a different perspective on the situation – for example, by encouraging a more positive view – sharers can be helped to change the way they think about the situation (i.e., reappraisal), which may change the emotions the situation elicits (Dobkin et al., 2004; Nils & Rimé, 2012; Panzarella et al., 2006; Rimé, 2009). Further speaking to its potential for fostering emotional recovery, reappraisal has generally been found to be the most adaptive way of regulating one's own emotions (Webb et al., 2012). Reappraisal lies at the heart of cognitive behavioral therapy (CBT), which is successful in treating a wide variety of disorders characterized by emotion regulation impairments (Butler et al., 2006; Hofmann et al., 2012). Importantly, however, despite the long-term benefits

associated with cognitive support, prior research has shown that sharers generally strongly prefer emotional support (Duprez et al., 2014; Pauw, Sauter, Van Kleef, et al., 2018, 2019), and may resist cognitive reappraisal by others as it can be experienced as invalidating (Marigold, Holmes, et al., 2014).

While direct comparative studies are lacking, there is indirect evidence suggesting that both forms of support may be (experienced as) helpful when sharing with virtual humans. Emotional support provided by a conversational agent can foster perceived responsiveness, and may thus elicit short-term emotional and relational benefits. For example, chatbots that displayed empathy when giving advice about a sensitive personal issue (e.g., by validating the negativity of the situation) were perceived as more supportive compared to chatbots that provided unemotional advice (Liu & Sundar, 2018). Furthermore, a set of studies in which participants interacted with a social robot showed that participants felt more understood, validated and cared for and preferred interacting with a robot that reacted responsively (non-verbal signs of attentive listening and verbal validation of participants' feelings) rather than unresponsively (neither non-verbal nor verbal feedback; Birnbaum et al., 2016a, 2016b; Hoffman et al., 2014). Similarly, talking to an empathic virtual agent was perceived as more enjoyable and more helpful than talking to a non-empathic virtual agent, and led to a greater intention to use the agent over a longer period of time (Lisetti et al., 2013).

Indirect evidence for the potential for virtual humans to provide effective cognitive support (and thereby facilitate reappraisal) comes from recently developed chatbots and other text-based smartphone interventions employing a wide variety of treatments, including the use of CBT principles (Fitzpatrick et al., 2017; Hoermann et al., 2017; Inkster et al., 2018; Ly et al., 2017). For example, several prototypes for treating depression and anxiety have shown moderate success (Fitzpatrick et al., 2017; Fulmer et al., 2018; Inkster et al., 2018). However, given that these apps did not focus solely on CBT, but employed mixed methods (e.g.,

dialectical behavior therapy, motivational interviewing, positive behavior support, behavioral reinforcement, mindfulness), these findings are not conclusive regarding the effectiveness of cognitive support: It is possible that other aspects of the chatbots' responses were driving the positive outcomes.

In sum, research on social sharing with humans shows that emotional support is associated with short-term emotional and relational benefits, whereas cognitive support has the potential to bring about more long-term emotional recovery (Rimé et al., 2020). However, no prior research has experimentally manipulated and compared the effectiveness of emotional and cognitive support provided by virtual humans. The present study thus contributes to the literature by comparing the effect of these two types of support in a standardized manner, across multiple emotional and relational outcomes.

1.3 The Present Study

In the present study, we examined whether sharing one's emotions with a virtual human would bring about socio-emotional benefits. On the basis of prior work speaking to the general potential of conversational agents for treating (mental) health problems, we hypothesized that people would feel better after talking about their emotions with a virtual human. Furthermore, we explored possible differences between emotional vs. cognitive support.

To this end, 115 participants engaged in social sharing with a virtual human who provided either emotional or cognitive support. Participants had two conversations: One in which they shared a situation that made them feel angry and one in which they shared a situation that made them feel worried. These two emotion conditions were included in order to create variance in support needs. Previous research has shown that anger is linked to a preference for emotional support, whereas worry is associated with a desire for both emotional and cognitive support (Pauw, Sauter, van Kleef, et al., 2018). The virtual human

provided support through the Wizard-of-Oz paradigm, a frequently used method in computer-human interactions (Dahlbäck et al., 1993), in which participants are implicitly led to believe they are interacting with a computer, whereas in reality the avatar is controlled by a human experimenter (“wizard”). After each conversation, we assessed emotional intensity in relation to the disclosed situation (worry or anger), general affect, support efficacy, and relational closeness to the avatar. The present study thus allowed us to examine whether sharing one’s emotions with a virtual human elicits emotional relief, whether this depends on the type of support received, and whether this generalizes across different emotions.

2. Methods

2.1 Participants

A total of 115 participants ($M_{\text{age}} = 41.0$, $SD = 12.6$; 50% male) were recruited via Craigslist in Los Angeles, United States. 45.2% of the participants identified themselves as White, 30.4% as Black/African American, 13.9% as Asian/Pacific Islander, and 11.3% as Hispanic American. Eight participants had partially missing data because they could not recall an emotional event in one of the two conversations (5 participants), mixed up two events leading to conflated pre- and post-measures (2 participants) or failed to fill out a dependent measure (1 participant). The data of these participants could still be analyzed for at least one out of two conversations, and they were therefore only excluded from those analyses for which they had missing data. Informed consent was obtained from all individual participants included in the study.

2.2 Procedure

Upon arrival, participants were told that they would share two personal issues with our virtual agent Julie. Depending on their randomly assigned order condition, participants were first instructed to recall either a situation that still worried them or that still made them angry. Before sharing, participants were asked to write down the most important details of the

situation on an iPad, after which they answered questions about the event and their experienced emotions. Next, upon calling Julie by her name, the avatar appeared on a large screen in front of them, looking like a woman sitting in a chair similar to a therapy setting (see Figure 1).

Figure 1. Screenshot of our Virtual Human Julie.

In the first conversation, a short rapport-building phase was included in which Julie asked several introductory questions (e.g., “Where are you from originally?”; “Do you consider yourself more shy or outgoing?”) in order for participants to get acquainted with talking to Julie and to build rapport, which is conducive to self-disclosure (Lucas et al., 2014). Then Julie prompted the participant to tell her something about their anger (or worry) evoking experience. To standardize the conversations across participants, each conversation included three questions related to the emotional experience, and three instances of (either emotional or cognitive) support provision by Julie. If a participant spoke too little to allow contingent support provision, they were additionally prompted. Afterwards, Julie redirected participants

back to the survey, where participants rated their experienced emotional intensity, perceived support, support efficacy and experienced closeness to Julie.

Next, participants went through another round of recall (i.e., an anger or worry evoking situation), a second conversation with Julie, and the same pre- and post-conversational measures. At the end of the survey, participants answered some control questions regarding their experience of talking to Julie, and several demographic questions. Finally, we included a behavioral measure of participants' willingness to further interact with Julie. In total, participation on average took about 25 minutes.¹ The study protocol was approved by the Institutional Review Board of the University of Southern California, Los Angeles.

2.3 Design and Materials

This study involved a 2 (Support Type: Emotional vs. Cognitive Support) x 2 (Emotion: Anger vs. Worry) x 2 (Emotion Order) mixed design. Participants were asked to share both an anger and worry evoking situation (within subjects) in randomized order (between subjects) and received one of the two types of support (between subjects).

2.3.1 Emotion Recall

For anger, participants were asked to think of an issue they had with a friend or family member that still made them feel angry, and that had not yet been resolved. For worry, participants were instructed to think of an issue involving their work, finances or health that still made them feel worried, and that had not yet been resolved. We included these instructions to facilitate the construction of a repertoire of supportive responses that would fit any stories within these themes. Furthermore, in order to create variance and differentiate anger and worry instances, anger targeted a social situation, whereas worry did not.

¹ Additionally, before each conversation, we obtained background information regarding the shared event (e.g., recency, previous sharing, appraisals). We also included post-conversational ratings of desired support, interpersonal alerting and participants' prior experience with talking to a virtual human. These data fall outside the scope of this paper, but are available upon request.

Participants were asked to take a moment to write down the most important details of the situation in order to recall and relive what it was that made them so angry or worried.

2.3.2 Support

Participants received three instances of either emotional or cognitive support. These expressions of support were taken from separate repertoires of emotional and cognitive support that were established before data collection and tailored to the specific emotion. All responses were recordings of a human voice. Emotional support consisted of sentences expressing sympathy (e.g., “I’m sorry to hear that”), and validation (e.g., “You have every right to be angry with them”). Cognitive support was always directed at reappraising the situation by either trying to find a more positive way of looking at the situation (e.g., “It sounds like you’re learning though”), or by putting it in perspective (“Maybe with time they’ll come around”). See Table S1 in the Supplemental Materials for more examples per subcategory.

2.3.3 Control Questions

To ensure effective standardization across experimental conditions, participants were asked several control questions regarding their overall experience of talking to Julie (rated on a 7-point Likert scale (1 = *not at all/not well at all*, 7 = *very much/very well*). They were asked to what extent it bothered them that the conversation had been video recorded ($M = 2.20$, $SD = 1.54$), whether they found it difficult to talk about their personal situations with Julie ($M = 2.48$, $SD = 1.61$), how similar this conversation was to a conversation they normally have in their daily life ($M = 3.83$, $SD = 1.61$), and how well they thought Julie did as a conversation partner ($M = 4.58$, $SD = 1.57$). Overall, these questions revealed that participants had a relatively positive experience sharing with Julie.

2.3.4 Manipulation Check: Type of Support

To assess whether participants were sensitive to the kind of support they received, they rated their perceived support after each conversation using a 100-point slider bar (0 = *not at all*, 100 = *very much*). Emotional support was measured using four items (e.g., “Julie was empathic”; anger $\alpha = .94$, worry $\alpha = .93$). Cognitive support similarly was measured using four items (e.g., “Julie tried to help me look at the situation from a different perspective”; anger $\alpha = .93$, worry $\alpha = .95$). All items can be found in the Supplemental Materials (Supplement 1).

2.3.5 Manipulation Check: Emotion

Participants rated their experience of anger, worry, guilt, shame, fear, and sadness on a slider ranging from 0 (*not at all*) to 100 (*very much*) when thinking back at the recalled event before sharing the emotional situation. This allowed us to test whether participants indeed experienced the target emotion (i.e., worry for the worry conversation and anger for the anger conversation) most strongly.

2.3.6 Emotional Relief

We included two measures of emotional relief. First, participants rated their experience of the target emotion (i.e., worry or anger) again after sharing, on a slider ranging from 0 (*not at all*) to 100 (*very much*). This allowed us to compare the intensity of the target emotion pre- and post-sharing, assessing whether sharing resulted in a decrease in participants’ negative emotions in relation to the event they had talked about. Second, participants rated their general affective state on a scale from -5 (very negative) to +5 (very positive) before and after each conversation. The reason for both including the target emotion and general affect is that prior research has shown that social sharing may improve general affect (i.e., people report feeling better after sharing), but not necessarily decrease the target emotion (e.g., people still feel worried; Nils & Rimé, 2012).

2.3.7 Perceived Support Efficacy

Perceived support efficacy was measured using three items, adapted from Nils & Rimé (2012), which asked about the extent to which participants felt that the conversation had made them feel better, helped them deal with the situation better, and reduced their negative emotions regarding the specific event (anger $\alpha = .91$, worry $\alpha = .92$). All items were rated on a 7-point Likert scale (1 = *not at all*, 7 = *very much*).

2.3.8 Closeness

To assess experienced closeness, participants rated how connected they felt to Julie after each conversation on a 7-point Likert scale (1 = *not at all*, 7 = *very much*).

2.3.9 Desire to Interact with Julie

At the end of the study, participants were told they would need to wait five minutes until the experimenter could finish up the study and arrange payment. They were asked whether they preferred to talk to Julie a bit more, or to fill out another survey. After indicating their preference, they were told that they in fact did not have to wait and could call the experimenter. Choosing to talk to Julie was considered a behavioral indicator of a greater desire to interact with Julie.

3. Results

3.1 Standardization Check: Control Questions

To make sure that the experimental conditions did not result in any unintended differences in participants' experience of talking to Julie, we conducted a 2 (Support Condition: Emotional vs. Cognitive Support) x 2 (Emotion Order) MANOVA with all control questions described above included as dependent measures. Ratings on these control questions did not differ as a function of Support condition ($F[4, 108] = 0.41, p = .802, \eta_p^2 = .02$), Order condition ($F[4, 108] = 0.34, p = .852, \eta_p^2 = .01$), or their interaction ($F[4, 108] = 0.95, p = .437, \eta_p^2 = .03$), indicating successful standardization across experimental conditions. Thus, regardless of the support Julie provided or the emotion that was discussed, participants

were equally unbothered by the video recording, found it similarly easy to talk about their personal situations with Julie, rated the conversation as being equally similar to a daily conversation, and thought Julie did equally well as a conversational partner.

3.2 Manipulation Check: Type of Support

In order to test whether participants in the emotional (vs. cognitive) support condition indeed perceived more emotional support, and participants in the cognitive (vs. emotional) support condition perceived more cognitive support, a Repeated Measures ANOVA was conducted with Support Condition (Emotional vs. Cognitive Support) as a between-subjects variable, and Perceived Support (Emotional vs. Cognitive Support) and Emotion Condition (Anger vs. Worry) as within-subjects variables.² As expected, there was a main effect of Perceived Support ($F[1, 108] = 144.32, p < .001, \eta_p^2 = .57$), and a main effect of Support Condition ($F[1, 108] = 8.90, p = .004, \eta_p^2 = .08$). These effects were qualified by a significant interaction between Support Condition and Perceived Support ($F[1, 108] = 33.15, p < .001, \eta_p^2 = .24$).³

Contrary to our expectations, simple main effect analyses showed that there was no significant effect of Support Condition on perceived emotional support ($F[1, 108] = 0.11, p = .740, \eta_p^2 < .01$). Thus, regardless of the type of support that was provided by Julie, participants perceived an equally high amount of emotional support (see Table 1 for all means and standard deviations). There was, however, a significant effect of Support Condition on perceived cognitive support ($F[1, 108] = 23.00, p < .001, \eta_p^2 = .18$). In line with our expectations, those in the cognitive support condition perceived a significantly higher amount

² Including Emotion Order in our models revealed no statistically significant interactions with Emotion Order, indicating that all observed effects remain the same regardless of whether participants first shared an anger-evoking event and then a worry-evoking event, or vice versa. Therefore, we present all our analyses without Emotion Order in the model.

³ There was no main effect of Emotion Condition, $F(1, 108) = 0.29, p = .589, \eta_p^2 < .01$. Furthermore, there was no significant interaction between Emotion Condition and Support Condition, $F(1, 108) = 0.38, p = .542, \eta_p^2 < .01$, nor between Emotion Condition and Perceived Support, $F(1, 108) = 1.42, p = .236, \eta_p^2 = .01$.

of cognitive support compared to those in the emotional support condition. Finally, there was no significant three-way interaction between Support Type, Support Condition and Emotion Condition ($F[1, 108] = 0.53, p = .470, \eta_p^2 = .01$), indicating that our findings did not vary depending on Emotion Condition. In sum, our manipulation was only successful for the Cognitive Support condition: Participants experienced an equally high degree of emotional support across both support conditions, but perceived significantly more cognitive support when Julie provided cognitive (rather than emotional) support.

Table 1.

Means (M) and Standard Deviations (SD) of Perceived Support, Perceived Support Efficacy, Closeness, Emotional Intensity and General Affect split by Support Condition and Emotion Condition.

	Support Condition			
	Emotional Support		Cognitive Support	
	Anger	Worry	Anger	Worry
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Perceived Support				
Emotional Support	68.73 (26.87)	69.09 (26.63)	68.42 (25.34)	72.43 (24.30)
Cognitive Support	32.99 (28.58)	32.38 (29.17)	57.65 (30.13)	57.70 (30.50)
Perceived Support Efficacy	3.57 (1.66)	3.74 (1.75)	4.08 (1.62)	4.19 (1.70)
Closeness to Julie	4.20 (1.75)	3.96 (1.73)	4.29 (1.63)	4.54 (1.68)
Emotional Intensity of the Target Emotion				
Before Sharing	70.74 (25.87)	74.06 (24.93)	70.61 (31.18)	73.11 (26.75)
After Sharing	50.43 (26.84)	52.02 (26.17)	38.91 (27.86)	49.57 (30.04)

General Affect

Before Sharing	0.74 (2.69)	0.41 (2.57)	0.22 (2.45)	0.63 (2.59)
After Sharing	1.67 (2.19)	1.56 (2.26)	1.54 (2.02)	2.17 (1.85)

Note. Perceived Support and Emotional Intensity were measured on a scale from 0 (not at all) to 100 (very much). Perceived Support Efficacy and Closeness were measured on a scale from 1 (not at all) to 7 (very much). General Affect was measured on a scale from -5 (very negative) to +5 (very positive).

3.3 Manipulation Check: Emotion Recall

To verify whether participants indeed experienced more anger when recalling an anger experience and more worry when recalling a worry-evoking situation, we conducted a 2 (Emotion Condition: Anger vs. Worry) x 6 (Experienced Emotion: Anger, Worry, Sadness, Fear, Guilt and Shame) Repeated Measures ANOVA with both factors varying within subjects. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(14) = 60.13, p < .001$. Therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .85$). Main effects were observed for Emotion Condition ($F[1, 107] = 11.50, p = .001, \eta_p^2 = .10$), as well as Experienced Emotion ($F[4.23, 107] = 63.09, p < .001, \eta_p^2 = .37$). More importantly, a significant interaction was observed between Emotion Condition and Experienced Emotion ($F[4.23, 107] = 67.17, p < .001, \eta_p^2 = .39$).

Simple main effect analyses showed a significant effect of Emotion Condition on anger ($F[1, 107] = 99.19, p < .001, \eta_p^2 = .48$), indicating that those in the anger condition experienced more intense anger compared to those in the worry condition (see Table 2 for all means and standard deviations). Furthermore, Emotion Condition had a significant effect on worry ($F[1, 107] = 77.40, p < .001, \eta_p^2 = .42$), with those in the worry condition experiencing more intense worry compared to those in the anger condition. Moreover, pairwise

comparisons showed that within the anger condition, anger was experienced more intensely compared to all other emotions (all p 's < .001). Similarly, within the worry condition, worry was experienced more intensely compared to all other emotions (all p 's < .001). In sum, these findings demonstrate that our manipulation of emotion succeeded.

Table 2.

Means (M) and Standard Deviations (SD) of Emotional Intensity Ratings of Experienced Emotions Split by Emotion Condition

	Emotion Condition	
	Anger	Worry
	<i>M (SD)</i>	<i>M (SD)</i>
Experienced Emotions		
Anger	70.87 (28.48)	36.99 (34.10)
Worry	38.95 (32.59)	73.13 (26.05)
Guilt	21.37 (28.98)	30.02 (33.79)
Shame	22.50 (30.16)	27.08 (31.58)
Fear	23.50 (31.35)	58.35 (31.75)
Sadness	51.38 (33.69)	49.38 (33.92)

3.4 Main Analyses

3.4.1 Emotional Relief

We assessed the degree of emotional relief by examining both the target emotion and general affect. First, to examine whether the provision of support was effective in reducing the experienced negative emotion, we tested its effects on the intensity of the target emotion

before and after sharing. A 2 (Time: Pre and Post Sharing) x 2 (Support Condition: Emotional vs. Cognitive Support) x 2 (Emotion Condition: Anger vs. Worry) Repeated Measures ANOVA was conducted, with Time and Emotion Condition as within-subjects variables, Support Condition as between-subjects variable, and intensity of the target emotion (worry or anger) as the dependent measure.

In line with our hypothesis, there was a main effect of Time ($F[1, 105] = 127.43, p < .001, \eta_p^2 = .55$), indicating that overall, participants showed a reduction in the intensity of the target emotion after sharing with Julie (see Table 1). The absence of an interaction effect between Time and Support Condition ($F[1, 105] = 2.23, p = .139, \eta_p^2 = .02$) indicates that this reduction in intensity was equally strong in the emotional and cognitive support conditions. No three-way interaction was observed between Time, Support Condition and Emotion Condition ($F[1, 105] = 1.80, p = .183, \eta_p^2 = .02$), and no other effects emerged ($ps > .315$), except for a small effect of Emotion Condition ($F[1, 105] = 4.88, p = .029, \eta_p^2 = .04$), indicating that on average, participants experienced somewhat higher emotional intensity when discussing the worry-evoking event as compared to the anger-evoking event. In sum, regardless of the type of support, all participants indicated feeling less angry/worried after sharing.

Second, to assess whether emotional and cognitive support made participants generally feel better after sharing, we conducted a 2 (Time: Before and After Sharing) x 2 (Support Condition: Emotional vs. Cognitive Support) x 2 (Emotion Condition: Anger vs. Worry) Repeated Measures ANOVA, predicting General Affect. Here too, there was a main effect of Time ($F[1, 106] = 38.70, p < .001, \eta_p^2 = .27$), indicating that overall, participants generally felt better after sharing with Julie (see Table 1 for all means and standard deviations). The absence of an interaction effect between Time and Support Condition ($F[1, 106] = 0.97, p = .328, \eta_p^2 = .01$) indicated that the observed increase in affect was equally

strong across emotional and cognitive support provision. There was an interaction between Support Condition and Emotion Condition ($F[1, 106] = 4.46, p = .037, \eta_p^2 = .04$). Simple slope analyses, however, indicated that the effect of Support Condition was non-significant for both emotion conditions (all p 's $> .273$), meaning that emotional support and cognitive support were associated with similar affect across both anger and worry-evoking events. No three-way interaction was observed between Time, Support Condition and Emotion condition ($F[1, 106] < 0.01, p = 1.000, \eta_p^2 < .01$). In sum, regardless of the type of support that was provided, participants indicated that they felt better after sharing.

3.4.2 Perceived Support Efficacy

In order to examine whether the provision of emotional versus cognitive support differentially impacted participants' perceived support efficacy, a 2 (Support Condition: Emotional vs. Cognitive Support) x 2 (Emotion Condition: Anger vs. Worry) Repeated Measures ANOVA was conducted, with Support Condition as a between-subjects variable, Emotion Condition as a within-subjects variable, and perceived support efficacy as the dependent variable. No main effect of Support Condition was observed ($F[1, 108] = 2.75, p = .100, \eta_p^2 = .03$), indicating that the provision of emotional and cognitive support was judged to be similarly effective (see Table 1). Furthermore, there was no effect of Emotion Condition ($F[1, 108] = 1.08, p = .300, \eta_p^2 = .01$), nor an interaction effect between Support Condition and Emotion Condition, ($F[1, 108] = 0.06, p = .808, \eta_p^2 < .01$).

3.4.3. Closeness

Similarly, in order to examine whether the provision of emotional versus cognitive support differentially impacted felt closeness to Julie, a 2 (Support Condition: Emotional vs. Cognitive Support) x 2 (Emotion Condition: Anger vs. Worry) Repeated Measures ANOVA was conducted. Again, no main effect of Support Condition was observed ($F[1, 108] = 1.26, p = .264, \eta_p^2 = .01$). Furthermore, there was no effect of Emotion Condition ($F[1, 108] < 0.01, p$

= .974, $\eta_p^2 < .01$), nor an interaction effect between Support Condition and Emotion Condition predicting interpersonal closeness ($F[1, 108] = 3.08, p = .082, \eta_p^2 = .03$). Thus, these findings indicate that participants felt equally close to Julie after the provision of emotional and cognitive support (see Table 1).

3.4.4 Desire to Interact with Julie

To test whether support provision differentially impacted participants' desire to continue interacting with Julie, we conducted a Chi-Square test examining the relation between Support Condition (Emotional vs. Cognitive Support) and Willingness to Interact (Yes vs. No). Participants were equally willing to continue interacting with Julie regardless of whether she had provided emotional support (34.5% of participants chose to continue interacting) or cognitive support (43.1%; $\chi^2[1] = 0.87, p = .351, \Phi = 0.09$).

3.5 Supplemental Analyses

Our main findings show that sharing with a virtual human resulted in positive emotional and relational outcomes across both support conditions. However, given the absence of a control condition, these findings do not conclusively show that these benefits were due to the support received; they could merely reflect the benefit of talking. Therefore, we exploratorily examined whether support *perceived* by the participants also predicted positive emotional and relational outcomes (see Supplement 2.1). The results show that both perceived emotional and cognitive support were associated with increased emotional relief (as evidenced by improved general affect, though not by a decrease in the experience of the target emotion), greater closeness, and greater perceived support efficacy.

We also exploratorily examined which emotional and relational outcomes would predict the extent to which participants perceived the sharing interactions as effective. These results show that Post-Sharing Affect and Closeness were the only two significant predictors of Perceived Support Efficacy (see Supplement 2.2). These findings indicate that emotional

improvement in general affect (but not the target emotion) and greater closeness experienced towards Julie were predictive of participants perceiving the conversation as more effective in helping them down-regulate their negative emotions.

4. Discussion

4.1 Main Findings and Theoretical Implications

In light of the many obstacles people may face when seeking socio-emotional support in daily life, the present study was set up to examine virtual humans' potential for providing effective support. More specifically, we examined whether sharing with a virtual human might bring about socio-emotional benefits, whether this is dependent on the type of support provided, and whether this generalizes across two different emotions. To this end, participants shared two personal emotional events with a virtual human that gave either cognitive support (facilitating reappraisal) or emotional support (providing comfort and validation). Our findings show that participants felt better after talking about their emotions to a virtual human, as was evidenced by both a general improvement in mood and a decrease in negative emotion in response to the disclosed stressor. Emotional relief was similar for episodes of anger and worry, and when receiving emotional or cognitive support. Furthermore, both types of support were experienced as equally helpful in coping with the emotional experience, and led to a similar level of experienced closeness and desire to interact with the virtual human again.

Together, our findings thus speak to the potential of virtual humans in fostering successful coping. Prior research has shown that virtual humans uniquely create both emotional rapport and anonymity, thereby establishing a safe and non-threatening environment in which people feel comfortable disclosing their thoughts and feelings regarding personally upsetting events – at times to an even greater extent than when sharing among humans (Birnbaum et al., 2016a; Liu & Sundar, 2018; Lucas et al., 2014, 2017). Our findings complement this literature by showing that people also feel less intense negative emotions

after sharing with a virtual human, and that they perceive the interaction as helpful in coping with their emotions, regardless of the type of support that they received, and regardless of the type of emotional experience (anger and worry).

The finding that cognitive support yielded similar levels of emotional relief, perceived support efficacy, and relational closeness as compared to emotional support, suggests a certain degree of receptivity to cognitive support. These observations are promising in light of prior research on social sharing with humans, which has revealed a strong preference for emotional support (Duprez et al., 2015; Pauw, Sauter, van Kleef, et al., 2018, 2019). This preference for emotional support may be due to sharers' need for understanding (Reis et al., 2017): Emotional support validates the sharer's thoughts and feelings, which signals understanding and communicates that it is accepted and appropriate to feel the way they do (Shenk & Fruzzetti, 2011). Cognitive support, on the other hand, may be experienced as invalidating, as the listener tries to encourage *another* way of interpreting the event, which may lead the sharer to refuse the listener's support attempt (Marigold, Cavallo, et al., 2014). It is therefore noteworthy that in the current study, the provision of cognitive support did not come at the expense of perceiving the virtual human as sensitive: Those receiving cognitive support felt equally understood, and experienced the virtual human as equally empathic as did those who received emotional support. Furthermore, supplemental analyses showed that greater *perceived* cognitive support generally enhanced experienced benefits and closeness (see Supplement 2.1). It is thus possible that virtual humans may provide a unique way to circumvent the typical trade-off between empathetic and effective support provision.

One potential reason for greater receptivity to cognitive support from virtual humans concerns the different expectations that people may have about support from virtual humans as compared to real humans. The fulfillment of support expectations might be more important in shaping sharers' responses than the mere support itself (Bar-Kalifa & Rafaeli, 2015;

Sarason et al., 1990). Given that people generally do not ascribe actual mental experiences to agents, and assume that agents are worse at emotional tasks than humans (Gray et al., 2007; Waytz & Norton, 2014), they might be more forgiving when confronted with relatively insensitive or more direct ways of communication as compared to if a human would violate such norms. Consequently, they may perceive cognitive support as less judgmental (Pickard et al., 2016), and therefore potentially be more inclined to try to reappraise the situation. Furthermore, the provision of cognitive support – though not explicitly sympathetic in its verbal content – might have still communicated emotional involvement: By responding to the participant's story, these support instances may reflect that the virtual human was attending to and interpreting the participant's emotional experience and trying to help them feel better (Bodie & Jones, 2012; Burleson, 2008; Itzchakov et al., 2021; Jones, 2011).

The finding that participants were equally receptive to cognitive support as to emotional support is of particular importance given that the facilitation of adaptive reappraisals is key to emotional recovery when sharing in daily life, as well as in clinical settings (Butler et al., 2006; Lepore et al., 2004; Nils & Rimé, 2012; Rimé, 2009). Furthermore, the fact that the provision of cognitive support did not come at the cost of perceiving the virtual human as sensitive is promising, considering that people prefer to interact with more empathic virtual humans and are more motivated to have them as a companion in difficult times (Birnbaum et al., 2016a, 2016b; Liu & Sundar, 2018). Taken together, the current findings thus suggest that virtual humans can be a valuable source of social support.

4.2 Limitations and Future Directions

The present study has several limitations. First, given the absence of a control condition, it remains possible that the observed emotional and relational benefits were partially due to the mere act of talking about personal events with someone who listens and

asks follow-up questions. Indeed, active listening, by for example asking questions, is a key component of supportive communication (Bodie & Jones, 2012; Jones, 2011). Virtual humans may provide a unique benefit in that they offer unconditional attention without interrupting or shifting attention to themselves, while interactions between humans often lack these features (see Itzchakov et al., 2021). It should be noted, however, that our supplemental analyses suggest that the interaction with the virtual human did contribute to participants' experienced emotional relief. Firstly, those who experienced greater support experienced greater improvements in their affect, greater support efficacy and greater closeness to the virtual human (see Supplement 2.1). Secondly, greater affective improvement and greater closeness predicted higher perceived support efficacy (see Supplement 2.2). Thus, these findings speak to the added value of support provided by a virtual human. Nevertheless, future research is warranted to more conclusively map sharers' responses to support from virtual humans. These studies could include a comparison between human and virtual human sharing partners, for example by letting participants believe that the virtual human they are interacting with is operated by a human versus automation. Furthermore, in order to examine the added value of emotional and cognitive support for fostering socio-emotional benefits of sharing, a control condition could be included in which participants do not share, or share in the absence of a sharing partner (e.g., by writing, or recording a voice or video message).

Another shortcoming is that our findings only speak to self-reported short-term emotional relief, but not to actual (long-term) emotional recovery. In addition to the immediate reduction in emotional intensity, we assessed sharers' experienced support and their perceptions of helpfulness. It is thus possible that our findings merely reflect *perceived* efficacy (Zech & Rimé, 2005). Nevertheless, the finding that sharers experienced cognitive support as beneficial is promising, as it reflects receptivity to a form of support that is known to enhance long-term emotional recovery (e.g., Nils & Rimé, 2012b). Yet, it remains an open

question whether participants adopted the reappraisals that they were pointed towards. Future research is warranted to examine longer-term consequences of support provision by virtual humans, ideally assessing emotional and relational outcomes across a wider domain (e.g., appraisals, emotions, physical wellbeing, continued use of the virtual human).

These limitations notwithstanding, the present study is characterized by several strengths. The present findings show that talking to a virtual human effectively reduces the emotional intensity of the shared emotional experience, thereby speaking to virtual humans' potential in bringing about short-term emotional relief. Moreover, the current study compared the effectiveness of two support strategies by employing a standardized experimental procedure that ensured similar engagement across conditions and relied on operationalizations based on theoretically defined constructs. As such, we complement prior work that has typically been limited to small sample sizes and has not consistently compared different supportive responses by virtual humans, shedding new light on people's socio-emotional responses to sharing with virtual humans.

Future research could examine the application of the current findings. The present study employed the Wizard-of-Oz paradigm (Dahlbäck et al., 1993), with a human selecting the most appropriate response from a support repertoire to allow us to match the support to the specific situation at hand. The next step would be to automatize support provision. While the application of virtual humans is still in its infancy, we do believe there is potential for doing so: With technology rapidly improving, artificially intelligent virtual humans are being built that are capable of controlling computer-generated bodies and interacting verbally and non-verbally with other users in virtual environments (Rizzo et al., 2011). Furthermore, certain virtual human agents are capable of automatically detecting people's non-verbal behaviors (so-called 'affective markers') that are predictive of their psychological distress (e.g., depression, anxiety and post-traumatic stress disorder symptoms; DeVault et al., 2014;

Lucas et al., 2015; Ring et al., 2016; Scherer et al., 2014, 2013), which may be leveraged to further increase their sensitivity as conversation partners.

4.3 Conclusions

Taken together, the present study examined virtual humans' potential for providing complementary benefits to human support provision by overcoming typical obstacles to effective sharing. Extending prior research showing that people are willing to disclose personal information and talk about their emotions with a virtual human (DeVault et al., 2014; Gratch et al., 2014; Lucas et al., 2017), we demonstrate that people feel better after talking to a virtual human. The provision of cognitive and emotional support both effectively reduced short-term emotional distress and yielded similar levels of perceived support efficacy and experienced closeness. These findings thus suggest that virtual humans may have unique potential in reducing sharers' resistance to cognitive support – a form of support that is considered necessary for effective long-term recovery, yet is often resisted by sharers. Hence, although we do not conceive of virtual humans as a replacement for humans, we do conclude that virtual humans may be a valuable addition for those who may, at times, lack appropriate support from close others or clinicians.

Author Contributions

Lisanne S. Pauw: Conceptualization, Methodology, Investigation, Formal Analysis, Data Curation, Writing – Original Draft, Visualization. **Disa A. Sauter:** Conceptualization, Writing – Review & Editing. **Gerben A. van Kleef:** Conceptualization, Writing – Review & Editing. **Gale M. Lucas:** Conceptualization, Methodology, Software, Resources, Writing – Review & Editing. **Jonathan Gratch:** Conceptualization, Methodology, Software, Resources, Writing – Review & Editing, Funding Acquisition. **Agneta H. Fischer:** Conceptualization, Methodology, Resources, Writing – Review & Editing, Funding Acquisition, Supervision.

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Supplemental Material

Supplement 1: Perceived Support Measure

In order to assess the support that participants perceived the virtual human Julie to have provided, participants were asked the following question: “Looking back at the conversation with Julie about the anger/worry evoking situation, to what extent do you agree with the following statements? Julie..”, followed by eight items rated on a scale from 0 (*not at all*) to 100 (*very much*):

Emotional support:

- (1) Showed compassion
- (2) Conveyed understanding
- (3) Was supportive
- (4) Was empathic

Cognitive support:

- (5) Tried to help me look at the situation from a different perspective
- (6) Tried to help me find meaning in what occurred
- (7) Provided an outside perspective
- (8) Put what occurred into perspective

Supplement 2: Additional Analyses

2.1. The Effects of Perceived Support

First, we examined whether *perceived* emotional and cognitive support predicted emotional relief. When predicting post-sharing emotional intensity, we controlled for emotional intensity reported prior to sharing, and when predicting post-sharing general affect, we controlled for general affect reported prior to sharing (see Table S2 for all test statistics). These findings showed that perceived support did not predict a reduction in emotional intensity of the target emotion experienced in response to the anger or worry-evoking event. In fact, perceived cognitive support predicted an increase in worry experienced after sharing. Perceived emotional and cognitive support did, however, predict improved general affect in both the worry and anger conditions: The more support participants felt they had received, the better they reported feeling afterwards.

Second, we conducted multiple regression analyses with perceived emotional and cognitive support as predictors of perceived support efficacy and closeness for the anger and worry conversations separately. As can be seen in Table S3, both for worry and anger, perceived emotional and cognitive support were significant positive predictors of perceived support efficacy, as well as experienced closeness. Thus, the more support participants felt they had received, the more they evaluated the conversation as having been helpful in coping with the event, and the closer they felt to Julie. However, a logistic regression analysis including perceived emotional and cognitive support for both the worry and anger conversation as predictors did not significantly predict the desire to talk more to Julie ($\chi^2[4] = 3.98, p = .408$), indicating that the degree of support that participants perceived did not affect their willingness to have another conversation with Julie (see Table S4 for separate coefficients).

2.2. Predictors of Perceived Support Efficacy

Finally, we exploratorily examined which emotional and relational outcomes would predict the extent to which participants perceived the sharing interactions as effective. To this end, we ran a multiple regression analysis with Perceived Support Efficacy as the dependent variable, and Pre-Sharing General Affect, Post-Sharing General Affect, Pre-Sharing Emotional Intensity (of the target emotion), Post-Sharing Emotional Intensity and Closeness as predictors. Given the absence of any effects of Emotion Condition in all of our analyses, we averaged all variables across the anger and worry conversations. The results showed that only Post-Sharing General Affect and Closeness were significant positive predictors of Perceived Support Efficacy (see Table S5). Thus, the better participants felt after talking to Julie and the more connected they felt to Julie while talking to her, the more they perceived the conversation as effective in helping them down-regulate their negative emotions.

Supplemental Tables

Table S1.

Examples of Emotional and Cognitive Support by Virtual Human Julie per Subcategory

Support Type	Example Support Expression
Emotional support	
Sympathy	“I’m sorry to hear that”
Validation of emotional experience	“You have every right to be angry with them”
Validation of appraisal	“That’s so unfair”
Validation of difficulty of situation	“It’s stressful not knowing how things will turn out”
Cognitive support	
Changeability of feelings	“Maybe you won’t continue to feel this way”
Changeability of situation	“Maybe with time they’ll come around”
Silver lining	“It sounds like you’re learning though”
Minimizing	“Maybe you don’t need to assume the worst”
Minimizing wrongdoer's intentions (only in Anger condition)	“They probably didn’t mean any harm”
Minimizing wrongdoer's foreknowledge (only in Anger condition)	“Maybe they didn’t realize how much it affects you”

Table S2.

Outcomes of Four Regression Analyses Predicting Post-Sharing Emotional Intensity (or Post-Sharing General Affect) by Perceived Emotional, Perceived Cognitive Support and Pre-Sharing Emotional Intensity (or Pre-Sharing General Affect), for Anger and Worry Separately.

	Post-Sharing			
	Emotional Intensity		General Affect	
	β	p	β	p
Anger Conversation				
Perceived Emotional Support	.15	.183	.30	.001
Perceived Cognitive Support	.03	.807	.29	.001
Pre-Sharing Emotional Outcome	.31	.001	.43	< .001
Worry Conversation				
Perceived Emotional Support	-.04	.683	.40	< .001
Perceived Cognitive Support	.22	.036	.20	.024
Pre-Sharing Emotional Outcome	.51	< .001	.39	< .001

Note. 'Pre-sharing emotional outcome' denotes pre-sharing *emotional intensity* experienced in response to the specific event in the models predicting post-sharing emotional intensity, and *general affect* in the models predicting post-sharing general affect.

Table S3.

Outcomes of Four Regression Analyses Predicting Perceived Support Efficacy and Closeness by Perceived Emotional and Cognitive Support, for Anger and Worry Separately.

	Perceived Support			
	Efficacy		Closeness	
	β	p	β	p
Anger Conversation				
Perceived Emotional Support	.25	.003	.49	< .001
Perceived Cognitive Support	.54	< .001	.36	< .001
Worry Conversation				
Perceived Emotional Support	.44	< .001	.40	< .001
Perceived Cognitive Support	.34	< .001	.43	< .001

Table S4.

Outcomes of a Logistic Regression Analysis Predicting Desire to Talk to Julie (0 = No, 1 = Yes) by Perceived Emotional and Cognitive Support during the Anger and Worry Conversations.

	Desire to Talk to Julie	
	<i>B</i>	<i>p</i>
Perceived Emotional Support (Anger)	0.02	.259
Perceived Cognitive Support (Anger)	< -0.01	.593
Perceived Emotional Support (Worry)	< -0.01	.918
Perceived Cognitive Support (Worry)	0.01	.427

Table S5.

Outcomes of a Regression Analysis Predicting Perceived Support Efficacy by Pre- and Post-Sharing Emotional Intensity, Pre- and Post-Sharing General Affect and Closeness.

	Perceived Support Efficacy	
	β	p
Pre-Sharing Emotional Intensity Target Emotion	-.07	.320
Post-Sharing Emotional Intensity Target Emotion	.06	.366
Pre-Sharing General Affect	.04	.632
Post-Sharing General Affect	.33	< .001
Closeness	.55	< .001