Prolonged Grief Disorder and the Association with Social Contact: An Experience Sampling Study

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Abstract

Introduction

Bereaved people who experience Prolonged Grief Disorder (PGD) symptoms could have problems with functioning in their social lives. Social contact is important for bereaved people since it improves one's well-being. It may be that social contact is associated with PGD symptoms, however, research with an objective measurement is still missing. This study examined to what extent social contact and PGD symptoms of bereaved people are associated and how the type of relationship moderates the effect between the perceived pleasantness of social contact and PGD symptoms of bereaved people.

Methods

To this end, Experience Sampling Methodology (ESM) was used. Eighty bereaved adults completed questionnaires about who they were with and how pleasant they evaluated their social contact five times a day for 14 days.

Results

The regression analysis that was used to answer the first research question showed that the amount of social contact has a significant and negative effect on the PGD symptoms of bereaved people. Moreover, the moderation analysis that was used to answer the second research question showed that the type of relationship moderates the effect between perceived pleasantness and PGD symptoms. Specifically, pleasant contact with people is negatively associated with PGD symptoms, and this effect is larger when the bereaved have contact with people outside their nuclear family than when it concerns contact with people within their nuclear family.

Conclusion

Future research could examine whether the same results apply in a non-COVID-19 situation since the pandemic caused social contact restrictions, which may have influenced the results of this study.

Keywords: Prolonged grief disorder, Social contact, Frequency of social contact, Perceived pleasantness, Experience sampling methodology

Contents

Prolonged Grief Disorder and the Effect of Social Contact: An Experience Sampling Study

Grieving is a natural process after someone lost a close person, and most people cope well with losing someone (Buur & Zachariae et al., 2024). Most bereaved people experience low levels of grief symptoms which will decrease gradually over time (Buur & Zachariae et al., 2024). However, some people grief longer and more intensely and are at risk for developing prolonged grief disorder (PGD) symptoms. According to (Lundorff et al., 2017), one out of ten people who lose someone is at risk of developing Prolonged Grief Disorder (PGD).

In 2022, PGD was included in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders Text Revision (DSM-5 TR) as a diagnosis (American Psychiatric Association, 2022). According to DSM-5 TR, PGD can be diagnosed 12 months after the loss and PGD symptoms should persist for more than one month (Eisma, 2023). PGD symptoms include intense yearning or longing for the deceased person and preoccupation with thoughts and memories of the deceased person. Furthermore, because of the death a bereaved person could experience identity disruption, marked sense of disbelief about the death, avoidance of reminders that the person has died, intense emotional pain (e.g. anger, guilt or sadness), emotional numbness, feeling that life is meaningless, difficulties with reintegrating into one's relationships and activities after the death, and intense loneliness (Eisma, 2023). PGD symptoms could also include functional impairment which affects one's social and professional life (Eisma, 2023).

According to an Experience Sampling Methodology (ESM) study, PGD symptoms of bereaved people may fluctuate throughout the day (Lenferink et al., 2023). This shows that grief changes and is not a static process with fixed stages as was previously thought (Lenferink et al., 2023). ESM is an intense data collection method whereby people repeatedly answer questions in their natural environment, often multiple times a day, for a long study period (Shiffman et al., 2008). This limits recall bias and maximizes ecological validity (Shiffman et al., 2008).

People who experience symptoms of PGD could have difficulties with functioning in their social lives, which could hamper their grieving process (Buur & Zachariae et al., 2024). Social contact is important for a bereaved person since it decreases the risk of developing emotional problems, lowers depression levels and leads to higher levels of perceived coping and subjective well-being (Prigerson & Vanderwerker, 2010). Especially frequent contact

with friends relates to a lower chance of developing emotional problems (Prigerson & Vanderwerker, 2010).

The quantity of social contact may be important since the longer bereaved people are isolated the slower their adjustment process (Kalantari et al., 2023). According to Wanza et al. (2023), bereaved people who feel disconnected have less social contact and more PGD symptoms. However, in the study of Ha & Ingersoll-Dayton (2011), no significant effect was found between the amount of social contact and their grief symptoms in widow(ers). Since the frequency of contact does not always have an effect on grief symptoms, it may be that the quality of relationships is also an important factor (Cacciatore et al., 2021). To elaborate, when social contact is perceived as negative it can decrease the well-being of a bereaved person (Ha & Ingersoll-Dayton, 2011; Prigerson & Vanderwerker, 2010; Wanza et al., 2023). Moreover, the results of Wagner et al. (2012) suggest that there may be a difference in social contact with different types of people since negative judgement from family members affected PGD symptoms of traumatically bereaved people more than general disapproval and recognition from others (e.g. friends, colleagues and neighbours).

In the study of Ha & Ingersoll-Dayton (2011), it seems that social support and the discrepancy between the desired amount of social contact and the actual amount of social contact the bereaved person has is more important than the frequency. The results of Ha & Ingersoll-Dayton (2011) showed that less frequent social contact was associated with more feelings of anger for bereaved people who experienced a discrepancy in the preferred and actual amount of social contact. Ha & Ingersoll-Dayton (2011) also found that all the grief symptoms that they measured (i.e. anxiety, despair, shock, anger, and intrusive thoughts), except for the grief symptom yearning, are affected by the discrepancy between the desired and actual amount of social contact. A reason for this can be explained by the attachment theory which suggests that this symptom represents a unique relationship with the deceased person. A friend or relative cannot replace the support that was given by this person, because the bereaved person yearns for the support that was given by the person they were close with (Ha & Ingersoll-Dayton, 2011).

Present study

Previous research has shown that the quantity and quality of social contact may influence the well-being and PGD symptoms of a bereaved person (Cacciatore et al., 2021; Wanza et al., 2023). Moreover, it could be that social contact with family could have a different effect on PGD symptoms than social contact with others (e.g. friends, colleagues or

neighbours) (Prigerson & Vanderwerker, 2010; Wagner et al., 2012). Nevertheless, there is limited research, with varied results, on social contact and PGD symptoms. Therefore, it is not clear whether the amount of social contact has an effect on PGD symptoms and if the quality of social contact with different types of relationships has a different effect on PGD symptoms (Cacciatore et al., 2021; Ha & Ingersoll-Dayton, 2011; Kalantari et al., 2023; Prigerson & Vanderwerker, 2010; Wanza et al., 2023). Furthermore, prior studies used recall-bias measurements in their studies, such as measuring self-estimating frequency retrospectively (Ha & Ingersoll-Dayton, 2011; Wanza et al., 2023). Therefore, research with an objective measurement of the relationship between social contact and PGD is still missing.

To partially fill in the gaps of knowledge identified above, in the present ESM study it was examined to what extent the frequency of social contact affects the PGD symptoms of bereaved people (RQ1) and how perceived pleasantness of social contact affects the PGD symptoms of bereaved people with the type of relationship as moderator (RQ2). For the first research question, it was expected that there would be a negative relationship between the amount of social contact and PGD symptoms. For the second research question, it was expected that the perceived pleasantness of the social contact impacts the level of PGD symptoms and that the type of relationship moderates the association between the perceived pleasantness of the social contact and the level of PGD symptoms.

Methods

Procedure and participants

This study is part of a larger project where bereaved people were studied. The data that was used in this study is from (Lenferink et al., 2022). The study is cross-sectional in nature. Only the variables relevant to this study were reported.

To recruit participants, advertisements were made and posted on the social networks of the research team. Furthermore, participants were recruited through websites for bereaved people. The data collection took place from January to March 2022. Participants of this study could take part in a lottery and win a 50-euro voucher. To be eligible to participate in this study, the participants needed to be over 18 years old and have a smartphone. Furthermore, participants could only participate if they had lost someone more than three months ago. If participants have or had been diagnosed with psychotic disorder or experienced thoughts about suicidality, they could not participate in the study and their data were excluded.

The study consisted of three phases. First, general invitations were sent by e-mail to the participants with information about the study. During part one (T1), participants took part in a telephone interview conducted by trained Master psychology students, in which the participants answered demographic questions and questions concerning for example PGD symptoms. The interviews lasted 47 minutes on average. After a few days, participants received an e-mail with a link to a YouTube video that explained how the participant could download and use the Avicenna app. Then, the second phase of the study started, namely the ESM phase, where the participants needed to fill in five short surveys per day for two weeks in the Avicenna app. They received a notification to fill in the survey between 8.30-9.30 AM, 11.30 AM-12.30 PM, 2.30-3.30 PM, 5.30-6.30 PM and 8.30-9.30 PM. After 10 and 20 minutes reminders were sent when the participant did not fill in the survey yet. They had one hour to fill in the survey after the first notification. Technical assistance was provided, and help was offered when the participants had questions. Two days after the two-week-long ESM phase the third phase started where a second similar telephone interview as T1 took place (T2). The answers to the ESM questions and PGD symptoms assessed at T2 were used to answer both research questions.

Measures

Traumatic Grief Inventory – Clinician Administered (TGI-CA)

At T2, TGI-CA was used to measure PGD symptoms in bereaved people. It consists of 22 questions about grief reactions measured on a scale from 1 to 5 (1=never, 2=seldom,

3=sometime, 4=often and 5=always) (Heeke et al., 2022). TGI-CA is an interview version of the Traumatic Grief Inventory – Self Report Plus (TGI-SR+) (Lenferink et al., 2022). An example of an item is: 'In the past month, did you find yourself longing or yearning for the person who died?' TGI-CA has good psychometric properties (Heeke et al., 2022). Cronbach's alpha of the current study was 0.93 at T2, which shows excellent reliability (Elham & Bhoi, 2023). The PGD symptoms scores were calculated by adding up all the 22 items, so the score could range from 22 to 110. If the score is 71 or higher, it indicates disturbed grief (Boelen et al., 2019).

ESM-items

The item 'Were you with other people in the past three hours?' was used to measure how often a person had social contact. When a person answered 'Yes with one other person' or 'Yes with multiple others' to the question it was counted as social contact. Subsequently, the amount of social contact was divided by the amount of completed ESM questionnaires by the same person.

The second item 'How would you evaluate the contact in the past three hours?' with a scale from zero (very unpleasant) to six (very pleasant) was used to measure the perceived pleasantness of the social contact. The average score of the overall pleasantness of the participant's social contact was calculated. Lastly, the item 'What is the relationship with the person you had most contact with in the past three hours' was used to measure the type of relationship that the person had social contact with. The participant could choose between relationship/partner/lover, children, parent, sibling, friend in a non-romantic sense, acquaintance, colleague/fellow student, or other. When the participant had social contact with their relationship/partner/lover, child, parent or sibling, the social contact was grouped as 'Nuclear family member' and when the participant had contact with their friend in a non-romantic sense, acquaintance, colleague/fellow student or other it was grouped under the variable 'Other'. After that, it was determined how many times the participant saw a nuclear family member compared to other people, by dividing the number of social interactions with a nuclear family member by the total amount of social contact. A high ratio would mean that the bereaved person had more social contact with nuclear family members and less with others. A low ratio would mean that the bereaved person had more social contact with others and less with nuclear family members. For more information about the study procedure and the development of the ESM questionnaire, see (Lenferink et al., 2022) who used the same study sample.

Data Analysis Plan

To analyze the data, R (version 4.4.0) was used. The data was transferred into a .sav file and was further used in RStudio (See Appendix for the full R code). The data was cleaned by omitting the data of the participants who did not fill in T2 and missed more than half of the items of the ESM phase.

For the first research question, a regression analysis was performed where the frequency of social contact is the independent variable and the level of PGD symptoms of T2 of the same participant is the dependent variable. First, the assumptions of linear regression were checked. After that, a regression analysis was performed to evaluate the relationship between the frequency of social contact and PGD symptoms.

A moderation analysis was used to test the second research question. The perceived pleasantness, which was rated on a scale from 0-6 is the independent variable, the PGD symptoms of T2 are the dependent variable and the ratio of time spent with nuclear family members is the moderator. The assumptions were checked prior to performing the moderation analysis.

Results

Demographics and Loss-related Characteristics

Eighty people completed T1 and started the ESM phase. Five people did not complete the T2 interview, and 25 participants missed more than half of the observations and were therefore removed leading to 50 participants included in the analyses. In the sample, the majority of the participants were female (72%). Moreover, the most common nationality in the sample was German (56%). The mean age was 40.9 (*SD* = 2.34) years old with the youngest participant being 21 and the oldest person 75. Most participants lost their parent (n = 25), followed by their grandparent (n = 7) and partner (n = 6). The loss happened on average 6.3 (*SD* = 0.92) years ago prior to completing participation in this study, with a minimum of 5 months ago and a maximum of almost 27 years ago. Lastly, the PGD score was on average 30.90 (*SD* = 1.55) and one person probably experienced PGD. For more information about the sample see Table 1.

Table 1

Characteristics of the sample (N =50)

Background and loss characteristics	
Gender, *N* (%)	
Male	14 (18)
Female	36 (72)
Other	0 (0)
Age in years, *M* (*SD*)	40.9 (2.34)
Country of birth, *N* (%)	
Germany	28 (56)
The Netherlands	21 (42)
Indonesian	1 (2)
Level of education, *N* (%)	
Lower than college/university	21 (42)
College/university	29 (58)
Cause of death, *N* (%)	
Natural cause (e.g. illness)	41 (82)
Suicide	4 (8)

Accident	0 (0)
Homicide	1 (2)
Other	4 (8)
Unexpectedness of the death (1 to 5), *M* (*SD*)	3.36 (0.22)
Relationship with deceased person, *N* (%)	
Parent	25 (50)
Grandparent	7 (14)
Partner/spouse	6 (12)
Sibling	4 (8)
Friend	2 (4)
Other	6 (12)
Time since loss in years, *M* (*SD*)	6.3 (0.92)
Received professional grief support, *N* (%)	16 (32)
Currently receiving professional grief support, *N* (%)	4 (8)

Amount of Social Contact and the Effect on PGD Symptoms

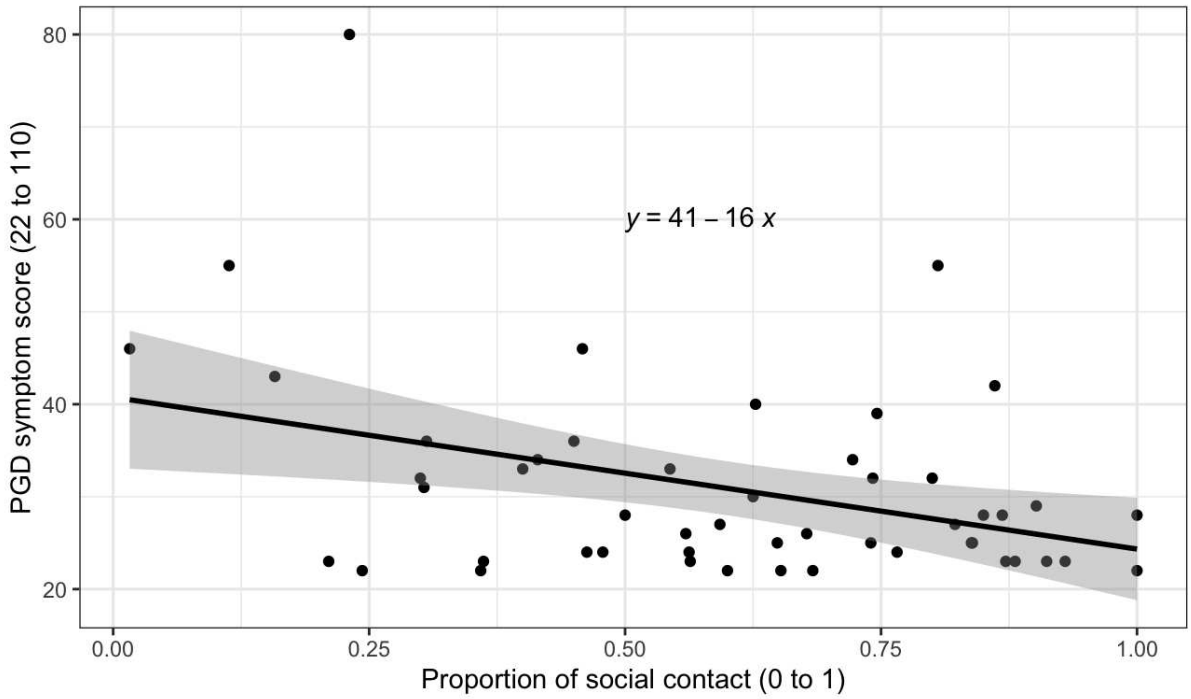
All assumptions except the normality assumption were met for the first research question. Since the sample size is large enough (> 40) the violation of normality should not cause serious problems and therefore a parametric procedure was followed (Ghasemi & Zahediasl, 2012).

People had on average 30.58 (*SD* = 2.06) out of 70 times social contact in two weeks. The regression analysis indicated that participants who have more frequent social contact experience less severe PGD symptoms, adjusted R^2 = .12[1], $F(1,48) = 7.87$, B = -16.42, p = .007, 95% CI [-28.18, -4.65] (See Figure 1). The *p*-value and *F*-value suggest that the amount of social contact explained the variance in the PGD symptoms. According to the adjusted R-squared, which is 12 per cent, the variance in PGD symptoms explained by the amount of social contact has a very weak effect size.

[1] An R-squared of 0.00-0.199 is considered to be a very weak effect size, 0.20-0.399 is a weak effect size, 0.40-0.599 is a medium effect size, 0.60-0.799 is a strong effect size and 0.80-1.00 is a very strong effect size (Sarjana et al., 2023).

Figure 1

Prolonged grief disorder symptom scores as a function of social contact



Effect of Perceived (Un)pleasantness on PGD Symptoms by Type of Relationship

One participant was not included in the analysis for the second research question since it was an outlier according to Cook's test. The participant saw their family only once and had therefore only one observation.

In Table 2 it can be seen how often participants had social contact with a certain type of relationship during the ESM phase calculated in percentage. Furthermore, the mean pleasantness per type of relationship is shown. Participants saw their partner most often during the two-week measurement, namely 33% of the time, followed by their colleague/fellow student who they saw 18% of the time. Furthermore, social contact with children (M = 5.16, SD = 0.86) was perceived as most pleasant and social contact with colleagues/fellow students (M = 4.44, SD = 0.85) and other people (M = 4.44, SD = 0.99) was perceived as least pleasant.

Table 2

Overview of how often participants had social contact with a certain type of relationship and the mean pleasantness of the social contact per type of relationship.

Type of relationship	Social contact (%)	Pleasantness, *M* (*SD*), range 0-6
Relationship/partner/lover	32.69	4.97 (1.01)
Colleague/fellow student	17.75	4.44 (0.85)
Child(ren)	13.68	5.16 (0.86)
Friend in a non-romantic sense	11.31	5.12 (0.88)
Other	11.18	4.44 (0.99)
Parent	6.52	4.98 (0.85)
Sibling	4.19	5.06 (0.79)
Acquaintance	2.68	4.53 (0.94)

In Table 3 the parameter estimates for the moderation model can be found. The effect of average perceived pleasantness on PGD symptoms was statistically significant (B = -20.69, 95% CI [-30.01, -11.38], $p < 0.001$). Moreover, the interaction effect between average perceived pleasantness and the type of relationship was also found to be statistically significant (B = 24.21, 95% CI [9.32, 39.11], $p = 0.002$). The simple slope analysis showed that for people with a low nuclear family member ratio, meaning 1 *SD* below the sample mean, a one-unit increase in average perceived pleasantness was associated with a -12.02 decrease in PGD symptoms. For people with an average nuclear family member ratio, meaning the mean of the sample, a one-unit increase in average perceived pleasantness was associated with a -6.59 decrease in PGD symptoms. For people with a high nuclear family member ratio, meaning 1 *SD* above the sample mean, a one-unit increase in average perceived pleasantness was associated with a -1.16 decrease in PGD symptoms. The high level of the nuclear family member ratio was not statistically significant $p = 0.62$, 95% CI [-5.90, 3.58]. Overall, the model was found to be statistically significant with $p < 0.001$, adjusted $R^2 = 0.40$ and $F(3, 45) = 11.47$. The *p*-value and *F*-value suggest that the independent variables effectively explained the variance in the dependent. The adjusted R-squared suggests that the variation in the dependent variable was explained by the independent variables to a medium extent. In Figure 2 a visual representation can be seen of how the type of relationship moderates the relationship between average perceived pleasantness and PGD symptoms.

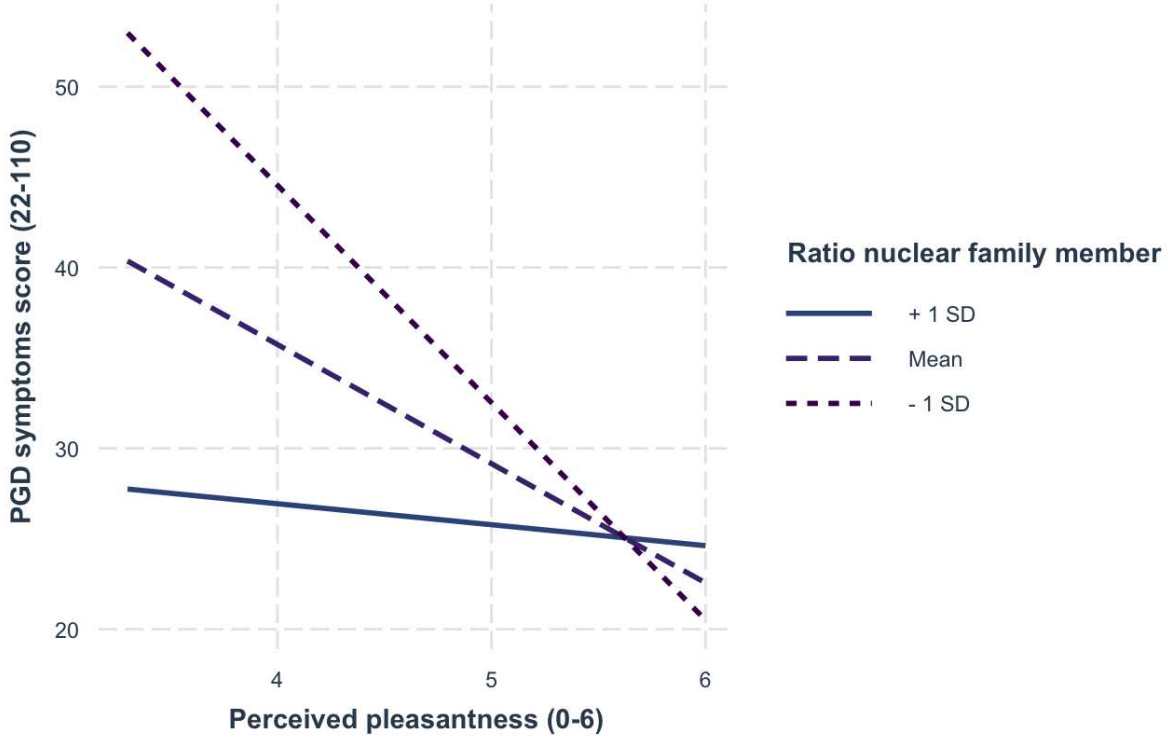
Table 3

Parameter estimates for the moderation model (N = 49)

Variable	B	SE	*P*-value	95% CI
PGD symptoms	141.39	23.43	< 0.001	[94.20, 188.58]
Average perceived pleasantness	-20.69	4.62	< 0.001	[-30.01, -11.38]
Ratio of time spent with nuclear family	-136.11	38.28	< 0.001	[-213.22, -59.01]
Average perceived pleasantness x Ratio of time spent with nuclear family	24.21	7.40	0.002	[9.32, 39.11]
Low level (-1 *SD*)	-12.02	2.36	< 0.001	[-16.77, -7.27]
Average level	-6.59	1.67	< 0.001	[-9.96, -3.22]
High level (+1 *SD*)	-1.16	2.35	0.62	[-5.90, 3.58]

Figure 2

Visual representation of how the type of relationship moderates the relationship between average perceived pleasantness and PGD symptoms.



Discussion

In this study, it was examined (1) to what extent the amount of social contact affects PGD symptoms of bereaved people and (2) how the perceived pleasantness affects PGD symptoms depending on the type of relationship. In general, a significant relationship was found in the first research question, meaning that the amount of social contact is negatively associated with the PGD symptoms of bereaved people. Moreover, a significant relationship was found in the second research question; The effect between perceived pleasantness and PGD symptoms depends on the type of relationship.

This study found that less frequent social contact is associated with higher PGD symptoms. This result is in line with the research of Wanza et al. (2023), but not with the research of Ha & Ingersoll-Dayton (2011). The study of Wanza et al. (2023) found that people who feel more disconnected and have less frequent social contact have higher PGD symptoms. In contrast, Ha & Ingersoll-Dayton (2011) found that the quality and congruence between desired and actual social contact is important, but not the frequency. It could be that the study of Ha & Ingersoll-Dayton (2011) showed different results since the amount of social contact only included friends, relatives and neighbors and no other types of people. Moreover, in the study of Ha & Ingersoll-Dayton (2011), only long in-depth social contacts were tested. For example, in this study, they asked the following questions: 'In a typical week, about how many times do you talk on the phone with friends, neighbors or relatives?' and 'How often do you get together with friends, neighbors, or relatives and do things like go out together or visit in each other's homes'. Whereas in the current study, all sorts of social contact were possible.

That frequent social contact is associated with less PGD symptoms, could be because frequent contact may distract a person from their grief and prevent a bereaved person from ruminating about the death of their loved one (Pociunaite et al., 2024). The results of the first research question can also be explained in terms of social isolation. Social isolation is the shortage of social contact and is related to poor mental health outcomes (Pitman et al., 2020). The results indicate that social isolation may be associated with higher PGD symptoms. However, the weak correlation between the frequency of social contact and PGD symptoms could indicate that besides the frequency of social contact, the quality of social contact is also important or maybe even more important. This suggestion would be in line with other research (Cacciatore et al., 2021; Ha & Ingersoll-Dayton, 2011).

The results of the second research question show that the effect between a bereaved person's perceived pleasantness of social contact and PGD symptoms depends on the type of relationship. The effect of the perceived pleasantness of social contact on PGD symptoms decreases when the nuclear family member ratio increases (i.e. more social contact with nuclear family members and less with others). Nevertheless, the high level of time spent with nuclear family members ratio did not reach statistical significance. This is in contrast with the results of (Wagner et al., 2012), where it was found that negative judgement from family members affected the PGD symptoms the most compared to general disapproval and recognition from others such as friends, colleagues and neighbors. In this study, the opposite was found; social contact perceived as negative with others is more strongly and negatively associated with PGD symptoms than unpleasant social contact with nuclear family members. However, the sample of Wagner et al. (2012) consisted of traumatically bereaved people who may react differently to social contact than naturally bereaved people. According to Hibberd et al. (2010), traumatically bereaved people experience more intense distress and impairments in functioning than bereaved people who experienced a natural loss. Not only do they have to cope with the loss, but they also need to cope with the shock and terror of the traumatic event. Furthermore, traumatically bereaved people often experience more stigma and insensitive reactions (Heeke et al., 2019). It could therefore be that traumatically bereaved people react differently towards social contact and the perceived pleasantness about this contact with certain types of people.

Moreover, the results of the second research question show that when the ratio of time spent with nuclear family members is low, meaning less social contact with nuclear family members and more with others, the perceived pleasantness of the social contact affects the PGD symptoms of a bereaved person a lot. This means that less pleasant social contact is associated with higher PGD symptoms and vice versa. That social contact with other people is associated with a bereaved person's PGD symptoms is in line with the research of Prigerson & Vanderwerker (2010) who mentioned that frequent contact with friends reduces the development of emotional problems.

The results of the second research question show a difference in social contact with nuclear family members and others. This difference is in line with other research which suggests that relationships with friends and family are perceived differently and have different mental health outcomes (Shor & Roelfs, 2015). Nuclear family members who are very close to a bereaved person could be too emotionally invested when a person experiences stress. On the other hand, friends usually share the same characteristics and values and could

therefore give better emotional and instrumental support that fits better to the problem at hand. Moreover, the results suggested that not only friends and family can be beneficial contacts but other people, such as 'weak ties' as well (Shor & Roelfs, 2015). This is also in line with the results of the current study.

Limitations and Future Directions

A limitation of this study is that it was conducted during the COVID-19 pandemic. Less social contact due to government restrictions during the pandemic is in general associated with lower well-being (Kalseth et al., 2023). The majority of the participants in this study are from Germany. According to Wong et al. (2023), Germans' daily number of social contacts was far less during the pandemic than before. For example, during the data collection, the number of visitors to places of retail and recreation (e.g. restaurants, cafés, shopping centers, museums and movie theatres) decreased from 10 to 25 per cent (Mathieu et al., 2020). Furthermore, the number of people who went to their workplace during the data collection decreased from 50 to 10 per cent. Because participants could see other people less frequently due to COVID-19, it could be that they have experienced a discrepancy in the amount of desired social contact and the actual amount of social contact (Ha & Ingersoll-Dayton, 2011). This could have increased feelings of anger in the participants and, therefore, potentially influenced their PGD symptoms (Ha & Ingersoll-Dayton, 2011).

Another limitation of this study is that the loss of bereaved people in this sample happened a relatively long time ago (M = 6.3 years, SD = 0.92) and that the PGD symptoms in this sample were relatively low. Therefore, the results in this study may not be generalizable to people who lost somebody recently. Furthermore, the type of loss was not distributed equally in the sample. Fifty per cent of the participants lost their parents. Moreover, there were no bereaved people in the sample who lost their child, so the results may not be generalizable to every type of loss.

Future research could examine if social contact and the perceived pleasantness thereof affect naturally and traumatically bereaved people's PGD symptoms differently. It would be interesting to examine this since the study of Wagner et al. (2012) with a traumatically bereaved sample reported different results than this study where the sample consisted mostly of naturally bereaved people. Additionally, future research could examine whether the amount of social contact and the perceived pleasantness of social contact depending on the type of relationship affect each PGD symptom separately. For example, Ha & Ingersoll-Dayton (2011) found that the PGD symptom yearning was not affected by the quality of

social contact. Therefore, the amount and perceived pleasantness of social contact may only relate to specific symptoms of PGD.

Conclusion

In conclusion, the amount of social contact may affect PGD symptoms. Indicating that more social contact is negatively associated with a bereaved person's PGD symptoms. Moreover, the results suggest that the effect between the perceived pleasantness of social contact and a bereaved person's PGD symptoms depends on how much time was spent with nuclear family members. When more time is spent with others (e.g. friends, colleagues, acquaintances), the perceived pleasantness of the social contact may result in a larger decrease in PGD symptoms than when more time is spent with nuclear family members. Furthermore, it may be that the quality of social contact is more important than the frequency. This study adds to the existing literature since this study is the first to objectively examine the associations between the number of times people had social contact and the pleasantness thereof on PGD symptoms, with social contact conceptualized as any type of interaction with another person.

References

American Psychiatric Association. (2022). *Diagnostic and Statistical Manual of Mental Disorders fifth edition text revision (DSM-5-TR)*. American Psychiatric Publishing. https://www.mredscircleoftrust.com/storage/app/media/DSM%205%20TR.pdf

Boelen, P. A., Smid, G. E., & Lenferink, L. I. M. (2019, October 21). *Traumatic Grief Inventory—Clinician Administered (TGI-CA) Manual*. Open Science Framework. https://osf.io/https://osf.io/zk6ed

Buur, C., Zachariae, R., Komischke-Konnerup, K. B., Marello, M. M., Schierff, L. H., & O'Connor, M. (2024). Risk factors for prolonged grief symptoms: A systematic review and meta-analysis. *Clinical Psychology Review*, *107*, 102375. https://doi.org/10.1016/j.cpr.2023.102375

Cacciatore, J., Thieleman, K., Fretts, R., & Jackson, L. B. (2021). What is good grief support? Exploring the actors and actions in social support after traumatic grief. *PLOS ONE*, *16*(5), e0252324. https://doi.org/10.1371/journal.pone.0252324

Eisma, M. C. (2023). Prolonged grief disorder in ICD-11 and DSM-5-TR: Challenges and controversies. *Australian & New Zealand Journal of Psychiatry*, *57*(7), 944–951. https://doi.org/10.1177/00048674231154206

Elham, O., & Bhoi, M. (2023). *Evaluation of Causes and Impact of Road Projects Delay in Afghanistan*.

Ha, J.-H., & Ingersoll-Dayton, B. (2011). Moderators in the Relationship between Social Contact and Psychological Distress among Widowed Adults. *Aging & Mental Health*, *15*(3), 354–363. https://doi.org/10.1080/13607863.2010.519325

Heeke, C., Franzen, M., Hofmann, H., Knaevelsrud, C., & Lenferink, L. I. M. (2022). A Latent Class Analysis on Symptoms of Prolonged Grief, Post-Traumatic Stress, and Depression Following the Loss of a Loved One. *Frontiers in Psychiatry*, *13*. https://doi.org/10.3389/fpsyt.2022.878773

Heeke, C., Kampisiou, C., Niemeyer, H., & Knaevelsrud, C. (2019). A systematic review and meta-analysis of correlates of prolonged grief disorder in adults exposed to violent loss. *European Journal of Psychotraumatology*, *10*(1), 1583524. https://doi.org/10.1080/20008198.2019.1583524

Hibberd, R., Elwood, L. S., & Galovski, T. E. (2010). Risk and Protective Factors for Posttraumatic Stress Disorder, Prolonged Grief, and Depression in Survivors of the

Violent Death of a Loved One. *Journal of Loss and Trauma*, *15*(5), 426–447. https://doi.org/10.1080/15325024.2010.507660

Kalantari, M., Zareei, H., & Sedrpoushan, N. (2023). A Qualitative Study on Prolonged Grief for the Loss of Spouse in the COVID-19 Pandemic: Exploring Lived Experience. *Journal of Community Health Research*. https://doi.org/10.18502/jchr.v12i6.12812

Kalseth, J., Ådnanes, M., Ose, S. O., Lassemo, E., Kaspersen, S. L., & das Nair, R. (2023). Comparing the effects of reduced social contact on psychosocial wellbeing before and during the COVID-19 pandemic: A longitudinal survey from two Norwegian counties. *Quality of Life Research*, *32*(6), 1771–1784. https://doi.org/10.1007/s11136-023-03350-z

Lenferink, L. I. M., van Eersel, J. H. W., & Franzen, M. (2022). Is it acceptable and feasible to measure prolonged grief disorder symptoms in daily life using experience sampling methodology? *Comprehensive Psychiatry*, *119*, 152351. https://doi.org/10.1016/j.comppsych.2022.152351

Lenferink, L., Terback, E., van Eersel, J. H. W., Zuidersma, M., Franzen, M., & Riese, H. (2023). *Fluctuations of prolonged grief disorder reactions in the daily life of bereaved people: An experience sampling study*. Manuscript submitted for publication.

Lundorff, M., Holmgren, H., Zachariae, R., Farver-Vestergaard, I., & O'Connor, M. (2017). Prevalence of prolonged grief disorder in adult bereavement: A systematic review and meta-analysis. *Journal of Affective Disorders*, *212*, 138–149. https://doi.org/10.1016/j.jad.2017.01.030

Mathieu, E., Ritchie, H., Rodés-Guirao, L., Appel, C., Giattino, C., Hasell, J., Macdonald, B., Dattani, S., Beltekian, D., Ortiz-Ospina, E., & Roser, M. (2020). Coronavirus Pandemic (COVID-19). *Our World in Data*. https://ourworldindata.org/coronavirus

Pitman, A. L., King, M. B., Marston, L., & Osborn, D. P. J. (2020). The association of loneliness after sudden bereavement with risk of suicide attempt: A nationwide survey of bereaved adults. *Social Psychiatry and Psychiatric Epidemiology*, *55*(8), 1081–1092. https://doi.org/10.1007/s00127-020-01921-w

Pociunaite, J., Kraiss, J., van Eersel, J., Franzen, M., & Lenferink, L. (2024). *Associations between contextual factors and prolonged grief reactions in daily life: An experience sampling study*. ResearchGate. https://doi.org/10.13140/RG.2.2.10757.77282

Prigerson, H. G., & Vanderwerker, L. C. (2010). Social support and technological connectedness as protective factors in bereavement. *Journal of Loss and Trauma*, *9*, 45–57. https://doi.org/10.1080/15325020490255304

Sarjana, K., Kurniawan, E., Lu'Luilmaknun, U., & Kertiyani, N. (2023). Analysis of Pre-Service Teacher's Performance Viewed by Creativity and Self-Regulated Learning. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, *9*, 234. https://doi.org/10.33394/jk.v9i1.6467

Shiffman, S., Stone, A., & Hufford, M. (2008). Ecolocial Momentary Assessment. *Annual Review of Clinical Psychology*, *4*, 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Shor, E., & Roelfs, D. J. (2015). Social contact frequency and all-cause mortality: A meta-analysis and meta-regression. *Social Science & Medicine*, *128*, 76–86. https://doi.org/10.1016/j.socscimed.2015.01.010

Wagner, B., Keller, V., Knaevelsrud, C., & Maercker, A. (2012). Social acknowledgement as a predictor of post-traumatic stress and complicated grief after witnessing assisted suicide. *International Journal of Social Psychiatry*, *58*(4), 381–385. https://doi.org/10.1177/0020764011400791

Wanza, C., Gonschor, J., Smith, K. V., Ehlers, A., Barke, A., Rief, W., & Doering, B. K. (2023). Feeling Alone in one's Grief: Investigating Social Cognitions in Adaption to Bereavement using the German Version of the Oxford Grief-Social Disconnection Scale. *European Journal of Trauma & Dissociation*, *7*(2), 100327. https://doi.org/10.1016/j.ejtd.2023.100327

Wong, K. L. M., Gimma, A., Coletti, P., Paolotti, D., Tizzani, M., Cattuto, C., Schmidt, A., Gredinger, G., Stumpfl, S., Baruch, J., Melillo, T., Hudeckova, H., Zibolenova, J., Chladna, Z., Rosinska, M., Niedzwiedzka-Stadnik, M., Fischer, K., Vorobjov, S., Sõnajalg, H., … CoMix Europe Working Group. (2023). Social contact patterns during the COVID-19 pandemic in 21 European countries – evidence from a two-year study. *BMC Infectious Diseases*, *23*(1), 268. https://doi.org/10.1186/s12879-023-08214-y

Appendix

R code

```
install.packages('lubridate')
install.packages("ggplot2")
install.packages("dplyr")
install.packages("broom")
install.packages("ggpubr")
install.packages("lmtest")
install.packages("interactions", dependencies = TRUE)
install.packages("viridis", dependencies = TRUE)
install.packages("effects")
install.packages("estimability")
install.packages("emmeans")
install.packages("tidyverse")
install.packages("foreign")
install.packages("modeldata")
install.packages("e1071")
install.packages("summarytools")
install.packages("topicmodels")
install.packages("viridisLite")
install.packages(“psych”)
#load packages
library(tidyverse)
library(foreign)
library(broom)
library(modelr)
library(dplyr)
library(lubridate)
library(ggplot2)
library(dplyr)
library(broom)
library(ggpubr)
library(lmtest)
```

```
library(car)
library(interactions)
library(viridis)
library(lme4)
library(effects)
library(estimability)
library(emmeans)
library(forcats)
library(modeldata)
library(e1071)
library(summarytools)
library(topicmodels)
library(viridisLite)
library(psych)

#get data file
PGD_SocialContact<-read.spss("ESM1_T1_ESM_T2.sav", to.data.frame=T)

#removing participants that have not done T2
WithoutT2 <- Suicidal %>%
  filter(!is.na(T2_StartDate))

#removing participants that have more than 50% of missing data
missing_percent2 <- WithoutT2 %>%
  group_by(QualtricsID) %>%
  summarize(missing_percent2 = mean(is.na(ESM_WhereWereYou)) * 100)
PercentRemoved <- WithoutT2 %>%
  group_by(QualtricsID) %>%
  filter(!(QualtricsID %in% missing_percent2[missing_percent2$missing_percent2 > 50,
]$QualtricsID))

missing_percent3 <- WithoutT2 %>%
  group_by(QualtricsID) %>%
  summarize(missing_percent3 = mean(is.na(ESM_WhereWereYou)) * 100)
```

```
PercentRemoved2 <- WithoutT2 %>%
  group_by(QualtricsID) %>%
  filter(!(QualtricsID %in% missing_percent3[missing_percent3$missing_percent3 > 50,
]$QualtricsID))

#summary of gender
summary(PercentRemoved)
summary(PercentRemoved$T1_Gender)
gender_counts <- PercentRemoved %>%
  group_by(T1_Gender) %>%
  summarize(count = n())
gender_counts$count

summary(gender_counts2$T1_Gender)

#merge both columns to calculate age
calculating_age$date_of_interview <- calculating_age2$T1_Date_of_interview

#correct one of changing dates to correct format
calculating_age$date_of_interview <- case_when(
  grepl("/", calculating_age$date_of_interview) ~ dmy(calculating_age$date_of_interview),
# DD/MM/YYYY format
  grepl("-", calculating_age$date_of_interview) ~ dmy(calculating_age$date_of_interview),
# DD-MM-YYYY format
  grepl("\\.", calculating_age$date_of_interview) ~ dmy(calculating_age$date_of_interview),
# DD.MM.YYYY format
  TRUE ~ NA_Date_
)

calculating_age$T1_DoB <- case_when(
  grepl("/", calculating_age$T1_DoB) ~ dmy(calculating_age$T1_DoB),
  grepl("-", calculating_age$T1_DoB) ~ dmy(calculating_age$T1_DoB),
  grepl("\\.", calculating_age$T1_DoB) ~ dmy(calculating_age$T1_DoB),
  TRUE ~ NA_Date_
```

```
)

calculating_age$age <- as.numeric(difftime(calculating_age$date_of_interview,
calculating_age$T1_DoB, units = "days")/365.25)

calculating_age$age <- floor(calculating_age$age)
summary(gender_counts2$T1_Gender)

#SD of age
sd_of_mean_age <- sd(calculating_age$age) / sqrt(length(calculating_age$age))
#Home country
country_counts2 <- PercentRemoved %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_Home_country)

summary(calculating_age$age)

#kinship
kinship_counts2 <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_kinship)
summary(kinship_counts2)

kinship_counts3 <- PercentRemoved %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_kinship_8_TEXT)
summary(kinship_counts3)

participant_number_other <- PercentRemoved2$QualtricsID[PercentRemoved2$T1_kinship
== "(Other)"]
print(participant_number_other)
participant_other <- subset(PercentRemoved2, T1_kinship == "Other")
unique(PercentRemoved2$T1_kinship)
PercentRemoved2$T1_kinship <- trimws(PercentRemoved2$T1_kinship)
```

```
unique(PercentRemoved2$T1_kinship)

#cause of death
cause_of_death <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_cause)
summary(cause_of_death)

cause_of_death2 <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_cause_5_TEXT)
summary(cause_of_death2)

#history grief support
now_support <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_griefsupport)
summary(now_support)

#currently support
now_support2 <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_currentsupport)
summary(now_support2)

#education
education_level <- PercentRemoved2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_Education)
summary(education_level)

#unexpectedness of death
scoring_system2 <- c("totally not unexpected" = 1,
                     "a little bit unexpected" = 2,
```

```
                "Quite unexpected" = 3,
                "very unexpected" = 4,
                "Totally unexpected" = 5)
unexpectedness2 <- PercentRemoved2[c("QualtricsID", "T1_A_un_expected")]
unexpectedness2$T1_A_un_expected <-
scoring_system2[as.character(unexpectedness2$T1_A_un_expected)]

unexpectedness2 <- unexpectedness2 %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_A_un_expected)
summary(unexpectedness2$T1_A_un_expected)

sd_unexpectedness <- sd(unexpectedness2$T1_A_un_expected) /
sqrt(length(unexpectedness2$T1_A_un_expected))

is.factor(PercentRemoved2$T1_A_un_expected)

#how long ago the death was
Date_of_death <- PercentRemoved %>%
  distinct(QualtricsID, .keep_all = TRUE) %>%
  count(T1_DoD)
summary(Date_of_death)

Date_of_death$T1_DoD <- case_when(
  grepl("/", Date_of_death$T1_DoD) ~ dmy(Date_of_death$T1_DoD),
  grepl("-", Date_of_death$T1_DoD) ~ dmy(Date_of_death$T1_DoD),
  grepl("\\.", Date_of_death$T1_DoD) ~ dmy(Date_of_death$T1_DoD),
  TRUE ~ NA_Date_
)

Date_of_death$year <- as.numeric(difftime(calculating_age$date_of_interview,
Date_of_death$T1_DoD, units = "days")/365.25)
summary(Date_of_death)
```

```
#SD of how long ago the death was
sd_of_mean_dod <- sd(Date_of_death$year) / sqrt(length(Date_of_death$year))

#creating data set with valuable variables for calculating frequency
calculating_frequency <- PercentRemoved[, c("ESM_WithOthers")]
calculating_frequency <- cbind(calculating_frequency, QualtricsID =
PercentRemoved$QualtricsID)

#to know the missing participant numbers in the frequency table
participant_numbers <- unique(PercentRemoved$QualtricsID)
print(participant_numbers)

#measuring frequency by with who they were with in past three hours
calculating_frequency <-
calculating_frequency[complete.cases(calculating_frequency$ESM_WithOthers,
calculating_frequency$QualtricsID), ]

calculating_frequency$social_contact <- ifelse(calculating_frequency$ESM_WithOthers ==
"Yes, with one other person" | calculating_frequency$ESM_WithOthers == "Yes, with
multiple others", "Yes", "No")

social_contact_counts <- calculating_frequency %>%
  group_by(QualtricsID) %>%
  summarise(social_contact_frequency = sum(social_contact == "Yes"))

#measuring frequency by keeping into account times person filled in questionnaire
calculating_frequency <- calculating_frequency %>%
  group_by(QualtricsID) %>%
  summarize(total_social_contact = sum(social_contact == 'Yes'),
            total_responses = n())
calculating_frequency <- calculating_frequency %>%
  mutate(average_social_contact = total_social_contact / total_responses)

#adjusting NA's
```

```
calculating_frequency$social_contact <- ifelse(is.na(calculating_frequency$social_contact), "No", calculating_frequency$social_contact)

#creating dataset TGI_CA T2
TGI_CA_T2 <- PercentRemoved[, 171:192]
TGI_CA_T2 <- cbind(TGI_CA_T2, QualtricsID = PercentRemoved$QualtricsID)

#creating scoring system for T2
scoring_levels <- c("1. Nooit" = 1, "2. Zelden" = 2, "3. Soms" = 3, "4. Vaak" = 4, "5. Altijd" = 5)
for (i in 1:22) {
  TGI_CA_T2[[paste0("v", i, "_score")]] <- scoring_levels[TGI_CA_T2[[paste0("T2_TGI_CA_1_", i)]]]
}

#calculating total score TGI_CA of T2
TGI_CA__T2_total_score <- score_correct_T2 %>%
  group_by(QualtricsID) %>%
  summarise(total_score = sum(v1_score + v2_score + v3_score + v4_score + v5_score + v6_score + v7_score + v8_score + v9_score + v10_score + v11_score + v12_score + v13_score + v14_score + v15_score + v16_score + v17_score + v18_score + v19_score + v20_score + v21_score + v22_score , na.rm = TRUE))

score_correct_T2 <- TGI_CA_T2 %>%
  distinct(QualtricsID, v1_score, v2_score, v3_score, v4_score, v5_score, v6_score, v7_score, v8_score, v9_score, v10_score, v11_score, v12_score, v13_score, v14_score, v15_score, v16_score, v17_score, v18_score, v19_score, v20_score, v21_score, v22_score, .keep_all = TRUE)

#combine frequency with PGD symptoms in one table
TGI_CA__T2_total_score <- cbind(TGI_CA__T2_total_score, social_contact_frequency = social_contact_counts$social_contact_frequency)
```

```
#combine frequency with PGD symptoms and taking into account how often they filled in the questionnaire
PGD_symptoms_social_contact <- cbind(calculating_frequency$average_social_contact, TGI_CA__T2_total_score$total_score)

#normal distribution not met
hist(TGI_CA__T2_total_score$total_score)

#lineairity
plot(total_score ~ social_contact_frequency, data = TGI_CA__T2_total_score)
plot(V2 ~ V1, data = PGD_symptoms_social_contact)

#new names for columns
names(PGD_symptoms_social_contact) <- c("average_social_contact", "PGD_symptoms")
names(PGD_symptoms_social_contact)
PGD_symptoms_social_contact <- as.data.frame(PGD_symptoms_social_contact)

#linear regression RQ1
PGD_symptoms_social_contact <- PGD_symptoms_social_contact %>%
rename(proportion_social_contact = average_social_contact)
PGD.social_contact.lm <- lm(PGD_symptoms ~ average_social_contact, data = PGD_symptoms_social_contact)

summary(PGD.social_contact.lm)
confint(PGD.social_contact.lm)

#check for homoscedascity
par(mfrow=c(2,2))
plot(PGD.social_contact.lm)
par(mfrow=c(1,1))

plot(PGD.social_contact.lm, which = 1)

#checking assumptions again
```

```
out <- PGD_symptoms_social_contact %>%
  lm(PGD_symptoms ~ average_social_contact, data = .)

print(bptest(out))
print(bptest(PGD.social_contact.lm))

resdulpdf<-density(out$resid)
plot(resdulpdf,main='Residual pdf shape Plot',xlab='Residuals')

plot(out ,which = 2)

plot(out,which=4)

#add residuals
PGD_symptoms_social_contact %>%
  add_residuals(out) %>%
  ggplot(aes(x = resid)) +
  geom_histogram()

summary(out$resid)

PGD_symptoms_social_contact %>%
  add_residuals(out) %>%
  add_predictions(out) %>%
  ggplot(aes(x = pred, y = resid)) +
  geom_point() +
  geom_smooth(method = "lm", color = "red", se = FALSE)


PGD_symptoms_social_contact %>%
  add_residuals(out) %>%
  ggplot(aes(x = average_social_contact, y = resid)) +
  geom_point() +
  geom_smooth(method = "lm", color = "red", se = FALSE)
```

```
#skewness level
skew_value <- skewness(out$resid)

#kurtosis
kurtosis_value <- kurtosis(out$resid)

shapiro.test(out$resid)

#qq plot
qqnorm(out$resid)
qqline(out$resid)

#linear regression
PGD_SocialContact.graph<-ggplot(PGD_symptoms_social_contact,
aes(x=average_social_contact, y=PGD_symptoms))+
  geom_point()
PGD_SocialContact.graph

PGD_SocialContact.graph <- PGD_SocialContact.graph + geom_smooth(method="lm",
col="black")

PGD_SocialContact.graph

PGD_SocialContact.graph <- PGD_SocialContact.graph +
  stat_regline_equation(label.x = 0.5, label.y = 60)

PGD_SocialContact.graph

#making graph prettier
PGD_SocialContact.graph +
  theme_bw() +
  labs(title = "PGD as a function of social contact",
       x = "Proportion of social contact (0 to 1)",
```

```
      y = "PGD symptom score (22 to 110)")

#descriptive statistics
summary(PGD_symptoms_social_contact$average_social_contact)
summary(PGD_symptoms_social_contact$PGD_symptoms)
sd_of_mean_pgd <- sd(PGD_symptoms_social_contact$PGD_symptoms) /
sqrt(length(PGD_symptoms_social_contact$PGD_symptoms))

#RQ2
#to know options of variarble how did you evaluate the contact
options4 <- levels(PercentRemoved$ESM_QualityContact)

#create dataset with QualtricsID, perceived pleasantness and type of relationship
perceived_pleasantness2 <- PercentRemoved2[, c("QualtricsID", "ESM_QualityContact",
"ESM_RelationshipOther")]

#Removing NA in ESM data
perceived_pleasantness2 <-
perceived_pleasantness2[complete.cases(perceived_pleasantness2$ESM_QualityContact,
perceived_pleasantness2$ESM_RelationshipOther), ]

perceived_pleasantness2 <-
perceived_pleasantness2[complete.cases(perceived_pleasantness2$ESM_RelationshipOther),
]

#recoding scores on scale of pleasantness
perceived_pleasantness2$ESM_QualityContact <-
as.character(perceived_pleasantness2$ESM_QualityContact)

perceived_pleasantness2 <- perceived_pleasantness2 %>%
  mutate(ESM_QualityContact = replace(ESM_QualityContact, ESM_QualityContact ==
"very unpleasant", 0),
         ESM_QualityContact = replace(ESM_QualityContact, ESM_QualityContact == "very
pleasant", 6))
```

```
#calculating average pleasantness per type of relationship per participant
average_pleasantness <- perceived_pleasantness2 %>%
  group_by(QualtricsID, ESM_RelationshipOther) %>%
  summarize(avg_perceived_pleasantness = mean(ESM_QualityContact))

#add PGD scores to pleasantness data set
average_pleasantness <- merge(average_pleasantness, unique(TGI_CA__T2_total_score[,
c("QualtricsID", "total_score")]), by = "QualtricsID", all.x = TRUE)

    #get mean and standard deviations of pleasantness and total score per type of relationship
    averages <- average_pleasantness %>%
      group_by(ESM_RelationshipOther) %>%
      summarise(avg_pleasantness = mean(avg_perceived_pleasantness, na.rm = TRUE),
                total_score = mean(total_score, na.rm = TRUE),
                std_dev_avg_pleasantness = sd(avg_perceived_pleasantness, na.rm = TRUE),
                std_dev_total_score = sd(total_score, na.rm = TRUE))

    #to see how many observations per type of relationship
    participant_counts <- table(average_pleasantness$QualtricsID,
average_pleasantness$ESM_RelationshipOther)
    participants_with_all_options <- apply(participant_counts, 1, function(x) all(x > 0))
    participants_with_all_options_id <-
names(participants_with_all_options)[participants_with_all_options]
    print(participants_with_all_options_id)

#save datasets
saveRDS(PGD_symptoms_social_contact, "RQ1_Dataset.rds")
saveRDS(PercentRemoved2, "BigDataset.rds")
saveRDS(average_pleasantness2, "RQ2_Dataset.rds")

#analyses after the meeting
#duplicate dataset in case goes wrong
backup_perceived_pleasantness2 <- perceived_pleasantness2
```

```
#recoding variable ESM_RelationshipOther
perceived_pleasantness2$ESM_RelationshipOther <-
ifelse(perceived_pleasantness2$ESM_RelationshipOther %in% c("Parent", "Sibling",
"Child(ren)", "relationship / partner / lover"), "Nuclear family member", "Other")

#calculating frequencies
perceived_pleasantness2_grouped <- perceived_pleasantness2 %>%
  group_by(QualtricsID) %>%
  summarise(Nuclear_family_member = sum(ESM_RelationshipOther == "Nuclear family
member"))

perceived_pleasantness2_grouped2 <- perceived_pleasantness2 %>%
  group_by(QualtricsID) %>%
  summarise(Other = sum(ESM_RelationshipOther == "Other"))

#combining two datasets
RQ2 <- cbind(perceived_pleasantness2_grouped, Other =
perceived_pleasantness2_grouped2$Other)

#adding third column total frequency
RQ2 <- mutate(RQ2, total_frequency = Nuclear_family_member + Other)

#adding fourth column dividing family member with total score
RQ2 <- mutate(RQ2, ratio_type_of_relationship = Nuclear_family_member /
total_frequency)

#turn pleasantness column into numeric
perceived_pleasantness2$ESM_QualityContact <-
as.numeric(as.character(perceived_pleasantness2$ESM_QualityContact))
#average pleasantness per participant
RQ2_avg_pleasantness <- perceived_pleasantness2 %>%
  group_by(QualtricsID) %>%
  summarise(avg_pleasantness = mean(ESM_QualityContact))
```

```
#adding avg pleasantness to RQ2
RQ2 <- cbind(RQ2, avg_pleasantness = RQ2_avg_pleasantness$avg_pleasantness)

#adding total PGD score
RQ2 <- cbind(RQ2, PGD_score = TGI_CA__T2_total_score$total_score)

#moderation
model_ratio3 <- lm(PGD_score ~ avg_pleasantness * ratio_type_of_relationship,
RQ2outlier2)
summary(model_ratio3)

#plot moderation
interactions::interact_plot(model_ratio3, pred = avg_pleasantness, modx =
ratio_type_of_relationship,
                            colors = viridis_colors)

interactions::interact_plot(
  model_ratio2,
  pred = avg_pleasantness,
  modx = ratio_type_of_relationship,
  colors = viridis_colors,
  x.label = "Perceived pleasantness (0-6)",
  y.label =  "PGD symptoms score (22-110)",
  legend.main = "Ratio nuclear family member"
)
#confidence interval
confint(model_ratio)

confint(model_ratio2)

#duplicate dataset to have back-up
RQ2outlier <- RQ2
```

```
#remove participant 512 since they only have one observation
RQ2outlier <- RQ2outlier %>%
  filter(QualtricsID != 512)

#checking assumptions again
model_ratio2 <- RQ2outlier %>%
  lm(PGD_score ~ avg_pleasantness * ratio_type_of_relationship, data = .)
summary(out3)

#add residuals
  RQ2outlier %>%
add_residuals(model_ratio2) %>%
  ggplot(aes(x = resid)) +
  geom_histogram()

summary(model_ratio2$resid)

RQ2outlier %>%
  add_residuals(model_ratio2) %>%
  add_predictions(model_ratio2) %>%
  ggplot(aes(x = pred, y = resid)) +
  geom_point() +
  geom_smooth(method = "lm", color = "red", se = FALSE)

RQ2outlier %>%
  add_residuals(model_ratio2) %>%
  ggplot(aes(x = avg_pleasantness, y = resid)) +
  geom_point() +
  geom_smooth(method = "lm", color = "red", se = FALSE)

#skewness level
skew_value_outlier <- skewness(model_ratio2$resid)

#kurtosis
```

```
kurtosis_value_outlier <- kurtosis(model_ratio2$resid)

shapiro.test(model_ratio2$resid)

#qq plot
qqnorm(model_ratio2$resid)
qqline(model_ratio2$resid)

#lineairity
plot(PGD_score ~ avg_pleasantness, data = RQ2outlier)

#homoscedasiticity
par(mfrow=c(2,2))
plot(model_ratio2)
par(mfrow=c(1,1))

#Independence of Residuals
print(dwtest(model_ratio2))

#RQ1 seeing if there is a difference without participant number 8
RQ1_outlier <- PGD_symptoms_social_contact[-8, ]

#linear regression without potential outlier
RQ1_outlier.lm <- lm(PGD_symptoms ~ average_social_contact, data = RQ1_outlier)

summary(RQ1_outlier.lm)

#linear regression without potential outlier (Cook's distance around 0.65)
PGD_SocialContact.graph2<-ggplot(RQ1_outlier, aes(x=average_social_contact,
y=PGD_symptoms))+
  geom_point()
PGD_SocialContact.graph2
```

```
PGD_SocialContact.graph2 <- PGD_SocialContact.graph2 + geom_smooth(method="lm",
col="black")

PGD_SocialContact.graph2

PGD_SocialContact.graph2 <- PGD_SocialContact.graph2 +
  stat_regline_equation(label.x = 0.5, label.y = 60)

PGD_SocialContact.graph2

#making graph prettier
PGD_SocialContact.graph2 +
  theme_bw() +
  labs(title = "PGD as a function of social contact",
       x = "Average social contact (0 to 1)",
       y = "PGD symptom score (22 to 110)")

#normal distribution without outlier for RQ2
hist(RQ2outlier$PGD_score)

#emmeans
res <- lm(PGD_score ~ avg_pleasantness + ratio_type_of_relationship +
avg_pleasantness*ratio_type_of_relationship,
          data=RQ2outlier)
summary(res)
cbind(coef(res), confint(res, level = 0.95))

m_pleasantness3<- mean(RQ2outlier$avg_pleasantness, na.rm = TRUE)
sd_pleasantness3<- sd(RQ2outlier$avg_pleasantness, na.rm = TRUE)

m_family<- mean(RQ2outlier$ratio_type_of_relationship, na.rm = TRUE)
sd_family<- sd(RQ2outlier$ratio_type_of_relationship, na.rm = TRUE)
```

```
emm <- emmeans(res,  ~ avg_pleasantness*ratio_type_of_relationship,
            cov.keep = 3, at = list(
              avg_pleasantness = c(m_pleasantness3-sd_pleasantness3, m_pleasantness3,
m_pleasantness3+sd_pleasantness3),
              ratio_type_of_relationship = c(m_family-sd_family, m_family,
m_family+sd_family)), level = 0.95)
summary(emm)

simpleSlope <- emtrends(res, pairwise ~ ratio_type_of_relationship, var =
"avg_pleasantness",
                    cov.keep = 3, at = list(

                      ratio_type_of_relationship = c(m_family-sd_family, m_family,
m_family+sd_family)), level = 0.95)
summary(simpleSlope)

emmip(res, ratio_type_of_relationship ~ avg_pleasantness,
      cov.keep = 3, at = list(
        avg_pleasantness = c(m_pleasantness3-sd_pleasantness3, m_pleasantness3,
m_pleasantness3+sd_pleasantness3),
        ratio_type_of_relationship = c(m_family-sd_family, m_family, m_family+sd_family)),
      CIs = TRUE, level = 0.95, position = "jitter")

simpleSlope <- emtrends(res, pairwise ~ ratio_type_of_relationship, var =
"avg_pleasantness",
                    cov.keep = 3, at = list(

                      ratio_type_of_relationship = c(m_family-sd_family, m_family,
m_family+sd_family)), level = 0.95) |> test()

#decriptive statistics
summary(RQ2outlier$Nuclear_family_member)
sum(RQ2outlier$Nuclear_family_member)
sum(RQ2outlier$Other)
```

```
#average pleasantness grouped by family and other
RQ2_avg_pleasantness_family <- perceived_pleasantness2 %>%
  group_by(ESM_RelationshipOther) %>%
  summarise(avg_pleasantness_family = mean(ESM_QualityContact))

#standard deviation
averages3 <- perceived_pleasantness2 %>%
  group_by(ESM_RelationshipOther) %>%
  summarise(mean_pleasantness = mean(ESM_QualityContact, na.rm = TRUE),
            std_dev_pleasantness = sd(ESM_QualityContact, na.rm = TRUE))

#summary avg pleasantness to get mean and SD
summary(RQ2_avg_pleasantness$avg_pleasantness)

sd_of_mean_pleasantness <- sd(RQ2_avg_pleasantness$avg_pleasantness) /
sqrt(length(RQ2_avg_pleasantness$avg_pleasantness))

#see if there is a ceiling effect in average pleasantness
hist(RQ2_avg_pleasantness$avg_pleasantness,
     main = "Histogram of Average Perceived Pleasantness",
     xlab = "Average Perceived Pleasantness",
     col = "lightblue",
     border = "black")
#boxplot
boxplot(RQ2_avg_pleasantness$avg_pleasantness,
        main = "Boxplot of Average Perceived Pleasantness",
        xlab = "Average Perceived Pleasantness",
        ylab = "Value",
        col = "lightblue",
        border = "black")

#denisity plot
plot(density(RQ2_avg_pleasantness$avg_pleasantness),
```

```
    main = "Density Plot of Average Perceived Pleasantness",
    xlab = "Average Perceived Pleasantness",
    ylab = "Density")

#Checking clustering upper limit
upper_limit <- max(RQ2_avg_pleasantness$avg_pleasantness)

num_at_upper_limit <- sum(RQ2_avg_pleasantness$avg_pleasantness == upper_limit)

proportion_at_upper_limit <- num_at_upper_limit / nrow(RQ2_avg_pleasantness)

#print
print(paste("Proportion at upper limit:", proportion_at_upper_limit))

summary(average_pleasantness$ESM_RelationshipOther)

summary(RQ2outlier2$ratio_type_of_relationship)

#check skewness of moderator
# Histogram
hist(RQ2outlier2$ratio_type_of_relationship,
    main = "Histogram of Type of Relationship",
    xlab = "Ratio type of relationship",
    col = "lightblue",
    border = "black")

#boxplot
boxplot(RQ2outlier2$ratio_type_of_relationship,
        main = "Boxplot of Ratio Type of Relationship",
        xlab = "Ratio nuclear family member",
        ylab = "Value",
        col = "lightblue",
        border = "black")
```

```
#denisity plot
plot(density(RQ2outlier2$ratio_type_of_relationship),
     main = "Density Plot of Ratio Type of Relationship",
     xlab = "Ratio Nuclear Family Member",
     ylab = "Density")

#Checking clustering upper limit
upper_limit <- max(RQ2outlier2$ratio_type_of_relationship)

num_at_upper_limit <- sum(RQ2outlier2$ratio_type_of_relationship == upper_limit)

proportion_at_upper_limit <- num_at_upper_limit / nrow(RQ2outlier2)

# Calculate mean and standard deviation
mean_value <- mean(RQ2outlier2$ratio_type_of_relationship, na.rm = TRUE)
sd_value <- sd(RQ2outlier2$ratio_type_of_relationship, na.rm = TRUE)

# Compute thresholds
one_sd_below <- mean_value - sd_value
one_sd_above <- mean_value + sd_value

# Print the results
cat(mean_value)
cat(sd_value)
cat(one_sd_below)
cat(one_sd_above)

#calculating proportion of frequency for descriptives RQ1
proportion_frequency <- PercentRemoved2[, c("QualtricsID", "ESM_RelationshipOther",
"ESM_QualityContact")]

#Removing NA in frequency and pleasantness to have same amount of participants as when
calculating average pleasantness per type of participant
```

```
proportion_frequency <-
proportion_frequency[complete.cases(proportion_frequency$ESM_QualityContact,
proportion_frequency$ESM_RelationshipOther), ]

#count how often participant saw each type of relationship
summary_proportion_frequency <- proportion_frequency %>%
  group_by(ESM_RelationshipOther) %>%
  summarise(count = n(), .groups = 'drop')

summary_proportion_frequency <- summary_proportion_frequency %>%
  mutate(total_response = 1528)

#adding column dividing frequency per type of relationship with total responses
summary_proportion_frequency <- mutate(summary_proportion_frequency, ratio_frequency
= count / total_response)

#summary
unique(summary_proportion_frequency$QualtricsID)

#sum ratio frequency per type of relationship and after divide it by 50 to also include people
who never saw certain type of relationship
sum_ratio_frequency <- summary_proportion_frequency %>%
  group_by(ESM_RelationshipOther) %>%
  summarise(sum_ratio_frequency = sum(ratio_frequency))

#adding number 50
sum_ratio_frequency <- sum_ratio_frequency %>%
  mutate(total_response = 50)

#adding column dividing frequency per type of relationship with total responses
sum_ratio_frequency <- mutate(sum_ratio_frequency, ratio_frequency =
sum_ratio_frequency / total_response)

#Calculating Cronbach's alpha
```

```
alpha_result <- alpha(alpha)
alpha <- score_correct_T2 %>%
  select(v1_score, v2_score, v3_score, v4_score, v5_score, v6_score, v7_score, v8_score,
v9_score, v10_score, v11_score, v12_score, v13_score, v14_score, v15_score, v16_score,
v17_score, v18_score, v19_score, v20_score, v21_score, v22_score)
print(alpha_result)
```