RESEARCH ARTICLE

Interpersonal problems and cooperative behavior in patients suffering from prolonged grief disorder as compared to bereaved healthy controls

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Abstract

Objectives: Interpersonal factors, such as impairments in social interaction or lack of social support, have an important share when it comes to the development, maintenance, and progression of various mental disorders.

Methods: Individuals suffering from prolonged grief disorder (PGD) and matched bereaved healthy controls ($n = 54$) underwent a thorough diagnostic procedure, further completed the Inventory of Interpersonal Problems (IIP-D-32), and participated in a finitely iterated prisoner's dilemma (FIPD).

Results: Individuals suffering from PGD reported significantly more interpersonal problems. Both groups behaved differently in the FIPD with healthy controls being more carefully, adapting their behavior more flexible, whereas PGD patients displayed a lower responsiveness, which may indicate an inability to adapt to changes in relationships.

Conclusion: We conclude that interpersonal problems appear to be a relevant feature of PGD. Future studies need to clarify the causal relation behind this link, and

should also include measures of attachment, social support, and disconnectedness.

KEYWORDS
behavioral economics, bereavement, interpersonal problems, prisoner's dilemma, prolonged grief disorder, social support

1 | INTRODUCTION

Grief following bereavement is a natural reaction most humans experience at some point in life. However, while most bereaved over time adapt to, integrate, and accept the loss, about 3%–4% experience a pathological form of grief, called prolonged grief disorder (PGD), which is characterized by a persistent longing for, or preoccupation with the deceased accompanied by intense emotional pain (Rosner et al. 2021; World Health Organization 2019).

Lack and insufficient social support, as well as social impairment, have been identified as risk factors for PGD (Burke & Neimeyer 2013; Lobb et al. 2010). PGD patients often experience people around them to be less willing to listen to them (Mancini et al. 2015). Furthermore, they are significantly more often told by family and friends that they are exaggerating or overreacting with their grief, using grief as an excuse, to get attention, or simply feeling sorry for themselves (Johnson et al. 2009). In addition to that individuals suffering from PGD often feel alienated from formerly close significant others after bereavement, which can be one explanation for their relatively high avoidance behavior, that is, avoidance of social situations, and pleasant activities (Mancini et al. 2015; Smith et al. 2020). This behavior, in turn, can cause feelings of social isolation and disconnectedness (Smith et al. 2020). This, and the risk of encountering unhelpful social responses, might explain why PGD patients often refrain from seeking social support (Smith et al. 2020).

The recently proposed *microsociological theory of adjustment to loss* emphasizes the importance of social connection following bereavement (Maciejewski et al. 2022). According to this model, the loss of a close relationship leads to social deprivation or disconnection. As a consequence, a void emerges, and social needs are not met. This social void can be filled by connecting with others, thereby reducing symptoms of grief, leading to feelings of social connectedness, and well-being. However, studies have shown that PGD is associated with insecure attachment and that PGD patients often have formed a very close, almost dependent relationship with the deceased, which makes it difficult for them to form new relationships (Burke & Neimeyer 2013; Maccallum & Bryant 2018; Mancini et al. 2015). In fact, PGD patients have been found to feel significantly closer to the deceased than to their closest living friend, and to experience higher than normal identity fusion with the deceased (Harrison et al. 2021). Such higher self-other fusion is associated with *more* empathy and altruism (Cialdini et al. 1997). Whether this characterizes the relationship of the patient only to the deceased or may be a more general interaction style in individuals prone to develop PGD has not yet been investigated.

If lack of social support and social impairment are associated with PGD, it makes sense to investigate the underlying reasons and dynamics. One possibility is that PGD is associated with interpersonal problems and unfavorable interaction behavior, which may impact social support.

Social impairment in mental disorders can be explained by deviations in cooperation (Ong et al. 2017). Behavioral economic games enable the assessment of cooperative behavior and decision making by imitating real-life social interactions in a controlled setting (Clark et al. 2013; Robson et al. 2020). One frequently used economic game is the prisoner's dilemma (Axelrod & Hamilton 1981). In the prisoner's dilemma, two players can decide to either cooperate or defect over a course of one or multiple turns. If one player defects while the other player cooperates, the defecting player receives the largest individual payoff, while the cooperating player is left with a payoff of zero. If both players decide to cooperate, both receive an equal, the second-highest, payoff. Finally, if both

players decide to defect, they both receive the second lowest payoff. If the same two players continue to play with each other for several rounds or turns, this iterated version is of special interest as it corresponds to regular real-life interaction (Rodebaugh et al. 2011). Studies have demonstrated the retest reliability and external validity of the prisoner's dilemma (Peysakhovich et al. 2014; Thielmann et al. 2020; Zettler et al. 2013). Furthermore, it appears that it does not have an impact on the outcome whether the game is hypothetical or incentivized (Thielmann et al. 2020).

The present study investigated interpersonal factors and social interaction behaviors of individuals suffering from PGD. We hypothesized, first, PGD patients would show significantly more interpersonal problems in comparison to equally bereaved healthy control participants in self-report measures. Second, by employing an economic game, we compared cooperative behavior in PGD patients with that of bereaved healthy controls. With this game, we simulated a repeated real-life interaction under controlled conditions. We were interested not only in the degree of cooperation the patients would show but also in the interactive dynamics of their game-playing. Given their predisposition towards insecure attachment and high self-other fusion (Burke & Neimeyer 2013; Harrison et al. 2021), we hypothesized that patients might show *social perseveration* in their cooperation behavior; that is, they would maintain other-concerned, cooperative behaviors, regardless of the partner's actions, thus showing a reduced willingness to negatively reciprocate any experienced defections. In a final step, we combine the first and the second approaches by showing that interpersonal problems mediate the behavioral peculiarities of PGD patients.

2 | METHOD

2.1 | Participants

We recruited 54 participants, of whom 27 were bereaved individuals who suffered from PGD (PGD-group) and 27 were bereaved, but mentally unimpaired individuals (No-PGD-group). Participants belonging to the PGD-group were originally seeking treatment for PGD and participated in a larger, still ongoing German-wide multicenter randomized controlled trial investigating the efficacy of two different treatments in bereaved subjects (Rosner et al. 2018). They participated in the present study before receiving treatment.

Participants belonging to the PGD-group had to be between 18 and 75 years old and had to fulfill the diagnostic criteria of PGD according to the consensus criteria (Prigerson et al. 2009). PGD had to be the principal diagnosis, although meeting the criteria for other Axis I psychopathology was allowed, except for acute psychotic disorder or a major substance-related disorder. A vast majority, that is, 19 of 27 (70.3%) participants fulfilled the criteria for at least one other diagnosis. All of them either fulfilled the criteria for depression ($n = 18$) or dysthymia ($n = 2$), or both. Five cases fulfilled the criteria for two additional diagnoses, one for three and one for four. The diagnoses fulfilled were as follows: agoraphobia and panic attacks ($n = 3$), somatization ($n = 2$), specific phobia ($n = 2$), social anxiety disorder ($n = 1$), and eating disorder ($n = 1$). Further inclusion criteria were sufficient knowledge of German and signed consent. Participants for the PGD-group were excluded if they had acute suicidal tendencies, underwent other psychotherapeutic treatment, had altered their dosage of antidepressants during the last 4 weeks, regularly used benzodiazepines, antipsychotics, or opiates, or participated in another intervention study.

Participants belonging to the No-PGD-group had indicated bereavement of a significant other at least 6 months before the examination. As for the PGD-group, further inclusion criteria for this group were sufficient knowledge of German and signed consent. Participants for the No-PGD-group were excluded if they had a history of any mental disorder past or present.

PGD patients were recruited through professional or self-referral, advertisement by website, information events at the outpatient clinic, email distribution lists, flyers posted in public areas, social media, and reports in local newspapers. Participants of the No-PGD-group were specifically recruited to match participants in the PGD-group

as closely as possible based on a variety of sociodemographic and loss-related variables (i.e., gender, age, time since loss). They were recruited via word-of-mouth, advertisement by website, email distribution lists, flyers posted in public areas, social media, and reports in local newspapers.

2.2 | Procedure

The study protocol was approved by the Ethics Committee of the Faculty Psychology and Sports Science of Goethe University Frankfurt and adheres to the Declaration of Helsinki. Before participants were invited to the laboratory at the facility of the Department of Clinical Psychology and Psychotherapy of Goethe University, where the assessment took place, potential candidates were screened on the phone. At the laboratory, eligible participants provided informed consent and were then interviewed either by the first author or by research assistants. Afterwards, participants completed self-report measures in a paper-pencil format and completed the flexible iterated prisoner's dilemma (FIPD), which was introduced as a social interaction game in which the participant would play with another person sitting at a computer opposite to them. The details of the game and the procedure are explained in the *measures* section. The software used for the administration of the game was z-Tree (Fischbacher, 2007). Data collection took place between June 2018 and February 2020.

2.3 | Measures

Sociodemographic data and *loss-related variables* were obtained in a customized semi-structured interview by a trained interviewer, as were the PG-13 and the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Axis I (SCID-I). All other measures presented are self-report measures provided by the participants.

The *SCID* is a semi-structured interview, which allows the assessment of current and lifetime Axis I psychopathology according to DSM-IV (First et al. 2002; Wittchen et al. 1997). It has good psychometric properties (Wittchen et al. 1997). We used the SCID in the present study to detect any other Axis I psychopathology.

The *Interview for Prolonged Grief-13* (PG-13) is a semi-structured interview, which was employed in the present study for the assessment of PGD (Prigerson & Maciejewski n.d.; Vogel et al. 2017) according to the consensus criteria proposed by Prigerson et al. (2009). The PG-13 contains 13 items, of which 11 symptom-related items are rated on a 5-point Likert scale (1 = *never/not at all*, 5 = *several times a day/extremely*) and the remaining two items require a dichotomous answer (yes–no). The original work reports good psychometric properties with an internal reliability of $\alpha = 0.82$ (Prigerson et al. 2009) ($\alpha = 0.96$ in the present sample).

The *Beck Depression Inventory-II* (BDI-II) was used to assess symptoms of depression (Beck et al. 1996; Hautzinger et al. 2009). Using a 4-point Likert scale, the 21 items measure symptoms during the past 2 weeks. Good internal consistencies have been reported for the American ($0.86 < \alpha < 0.92$) (Segal et al. 2008), as well as for German versions ($0.89 < \alpha < 0.93$) (Wintjen & Petermann 2010) ($\alpha = 0.97$ in the present sample).

The *Brief Symptom Inventory* (BSI) (Derogatis 1993; Franke 2000) was used to measure general mental distress over the past 7 days. The self-report questionnaire consists of 53 items that are answered on a 5-point-Likert scale (0 = *not at all*; 4 = *extremely*). The Global Severity Index (BSI-GSI) is the index of the perceived level of distress across all items reported in our study. High internal consistencies of $\alpha = 0.92$–0.95 have been reported for the German version (Franke 2000) ($\alpha = 0.98$ in the present sample).

The *Inventory of Interpersonal Problems* (IIP-D) is a self-report questionnaire assessing interpersonal problems in eight domains of interpersonal functioning (Horowitz et al. 1988, 2000, 2003): domineering/controlling (PA), vindictive/self-centered (BC), cold/distant (DE), socially inhibited (FG), nonassertive (HI), overly accommodating (JK), self-sacrificing (LM), and Intrusive/needy (NO). The underlying theory proposes that interpersonal behaviors

can be described by two different dimensions: affiliation (ranging from hostile/cold to friendly/warm behavior) and dominance (ranging from submissive to dominating behavior). The beforementioned domains can be regarded as specific combinations of these two dimensions. Originally, the IIP-D consisted of 64 items (IIP-D-64); however, for time and economic reasons, we used the shorter version (IIP-D-32), which contains 32 items (4 for each subscale), which need to be ranked on a 5-point Likert-scale (0 = *not at all* to 4 = *extremely*). The total score describes the extent of interpersonal problems, that is, the higher the value, the greater the impairment. Previous studies have shown moderate to high internal consistencies for the American (0.68 < α < 0.93) (Horowitz et al. 2003) and the German short version (60 < α < 0.85) (Thomas et al. 2011) (α = 0.91 in the present sample).

For our study, we developed the *FIPD* game comparable to the one introduced by Rodebaugh et al. (2011). As for the regular prisoner's dilemma, two players can decide to either cooperate or defect over the course of one or multiple turns. In this study, the participants played for 30 turns via computer, sitting opposite to one another in the same room, deciding simultaneously, and receiving feedback about the other player's action after each turn. Cooperation was indicated by sharing most tokens and defection by keeping most tokens. Participants were asked to virtually divide 10 tokens between themselves and a confederate player, usually a research assistant. If tokens were given to the other player, both received 2 points for each token, whereas when tokens were kept, the player keeping the tokens received 3 points for each token and the other none. The confederate player secretly adhered to a specific strategy, a combination of *raise the stakes* (Rodebaugh et al. 2011, 2013) and *tit for two tats* (Pulcu et al. 2015). On the one hand, we wanted to elicit cooperation by using *raise the stakes*, and on the other hand, portray real social interaction by using *tit for two* tats, which is considered a *forgiving/compassionate strategy* (Pulcu et al. 2015; Rodebaugh et al. 2011, 2013). The exact details of the strategy can be obtained from the Supplementary Information. However, in turns 12, 20, 23, and 27, the regular strategy was disrupted as the confederate player gave 0 tokens irrespective of the participant's decisions in the previous two trials. The aim of this *planned defection* was to assess the degree of insistent (rigid) responding despite the unforeseen violation; we predicted that PGDs would persevere in their cooperation behavior more than non-PGDs who would react flexibly by negatively reciprocating the defection. Before the game was played, the payoff matrix was explained by showing an example of how each player would receive points in a hypothetical turn on paper. At that point, the confederate player (either another research assistant or the first author) entered the room and was introduced to the participant. A practice round had to be played and both players had to calculate the points resulting from their decision of sharing and keeping tokens (i.e., cooperating and defecting) to ensure that the rules were truly understood. Directly after the FIPD, participants were asked to fill out another questionnaire and provide ratings on how they experienced the task and the confederate player.

2.4 | Statistical analysis

All analyses were carried out using the SPSS Software package (version 27; IBM Corp.). Descriptive statistics summarizing demographic and clinical characteristics are presented. Between-sample differences were tested for significance using t tests and χ^2 tests. Normal distribution was violated in some cases. We, therefore, replicated all analyses using non-parametric procedures. Since results did not change, we decided to uniformly report parametric statistics. Hypotheses were tested against the significance level of α = 0.05. To analyze performance in the FIPD, we used analysis of variance (ANOVA) with repeated measures across all turns and PGD caseness as a between-groups factor. We report Huynh–Feldt corrected p values to account for violations of sphericity. We analyzed three dependent measures in separate ANOVAs. First, we analyzed the *number* of tokens shared across trials indicating overall cooperation behavior. Second, we analyzed *variability* in token sharing by calculating the squared deviation of shared tokens from the group mean for each trial. Third, we examined *serial cooperation shifts* by computing the difference between shared tokens of each trial (x) and its preceding trial (x − 1). This measure was particularly interesting with regard to the four planned defection turns where we expected group differences in response flexibility.

3 | RESULTS

The two groups did not differ significantly in relevant sociodemographic or loss-related characteristics. Participants in the PGD-group scored higher than those in the No-PGD-group on measures of PGD (PG-13), depression (BDI-II) and general mental distress (BSI-GSI). They also scored significantly higher in interpersonal problems (IIP-D), overall, as well as in all subscales. The numerically highest scores for the PGD-group could be found in the subscales overly accommodating (JK), socially inhibited (FG), nonassertive (HI), and self-sacrificing (LM). See Table 1 for all comparisons.

TABLE 1 Demographic and clinical characteristics

	PGD-group	No-PGD-group	Test statistics
Age (M; SD)	55.59 (12.25)	56.00 (13.90)	$t(52) = 0.11$, $p = 0.91$
Gender (female/male)	24/3	22/5	$\chi^2(1) = 0.59$, $p = 0.44$
Time since loss (in months) (M; SD)	35.52 (59.48)	50.30 (56.87)	$t(52) = 0.93$, $p = 0.36$
Age of the deceased (M; SD)	54.26 (21.58)	70.11 (24.23)	$t(52) = 2.54$, $p < 0.05$
Gender decesed (female/male)	8/19	13/14	$\chi^2(1) = 1.95$, $p = 0.16$
Kinship			$\chi^2(2) = 1.89$, $p = 0.39$
Spouse/partner	10	6	
Parent	7	11	
Other	10	10	
Expectability (yes/no)	9/18	15/12	$\chi^2(1) = 2.7$, $p = 0.10$
PG-13 (M; SD)	42.30 (4.72)	16.03 (5.18)	$t(52) = -19.47$, $p < 0.001$
BDI-II (M; SD)	30.81 (8.27)	3.19 (3.06)	$t(52) = -16.27$, $p < 0.001$
BSI-GSI (M; SD)	1.50 (0.63)	0.20 (0.14)	$t(52) = -10.44$, $p < 0.001$
IIP-D (M; SD)	1.73 (0.34)	0.96 (0.33)	$t(52) = -8.39$, $p < 0.001$
IIP-D PA (M; SD)	0.85 (0.64)	0.38 (0.42)	$t(44.77) = -3.21$, $p < 0.01$
IIP-D BC (M; SD)	1.16 (0.68)	0.44 (0.38)	$t(40.75) = -4.85$, $p < 0.001$
IIP-D DE (M; SD)	1.66 (0.93)	0.58 (0.60)	$t(52) = -5.14$ $p < 0.001$
IIP-D FG (M; SD)	2.19 (0.72)	1.07 (0.59)	$t(52) = -6.22$, $p < 0.001$
IIP-D HI (M; SD)	2.17 (0.64)	1.41 (0.61)	$t(52) = -4.47$, $p < 0.001$
IIP-D JK (M; SD)	2.30 (0.55)	1.63 (0.62)	$t(52) = -4.17$, $p < 0.001$
IIP-D LM (M; SD)	2.13 (0.69)	1.38 (0.81)	$t(52) = -3.68$, $p < 0.01$
IIP-D NO (M; SD)	1.36 (0.58)	0.89 (0.58)	$t(52) = -3.56$, $p < 0.01$

Note: N for both groups = 27 (PGD-group) and 27 (No-PGD-group). IIP-D and the respective subscales: domineering/controlling (PA), vindictive/self-centered (BC), cold/distant (DE), socially inhibited (FG), nonassertive (HI), overly accommodating (JK), self-sacrificing (LM), and Intrusive/needy (NO). Kinship is reported as three different groups because all other subgroups (child, sibling, other family member, friend) had only very few cases each.

Abbreviations: BDI-II, Beck's Depression Inventory; BSI-GSI, Global Severity Index of the Brief Symptom Inventory; G-13, Interview for Prolonged Grief; IIP-D, Inventory of Interpersonal Problems.

3.1 | Impact of PGD diagnosis on performance in the FIPD

The mean number of tokens shared across all turns was not significantly different for the PGD-group compared to the No-PGD-group (see Table 2).

Giving, that is, shared tokens, on each turn for the two groups is depicted in Figure 1. The number of shared tokens across all 30 trials was not significantly different between the two groups, $F(1,52) = 2.22$, $p = 0.14$. However, the repeated-measures factor was significant, $F(29,1508) = 1.83$, Huynh–Feldt corrected $p = 0.012$, and the group × repeated measures interaction reached marginal significance, $F(1,52) = 1.47$, Huynh–Feldt corrected $p = 0.078$, partial $\eta^2 = 0.034$, indicating that the number of shared tokens tended to be distributed differently across the 30 trials for the two groups. Giving in the PGD-group rose quite steadily to a higher level relative to the No-PGD-group after a few initial trials, and then never went back down to the level of the first run. By contrast, giving in the No-PGD-group appeared less generous and more variable, and ended at a lower level on turn 30 than it had started with on turn 1. Thus, while giving in the PGD-group and the No-PGD-group did not differ in turn 1, it did so significantly in the final turn (see Table 2) where the PGD-group gave significantly more tokens than the No-PGD-group, $F(1,51) = 4.48$, $p = 0.039$, partial $\eta^2 = 0.08$. The group difference vanished when IIP-D was considered as a covariate in the ANOVA, $F(1,51) = 0.66$, $p = 0.421$, suggesting that interpersonal problems mediated the group difference in behavior on the last trial of the game.

Second, the *variability* of the tokens shared showed marginally significant differences between groups, $F(1,52) = 3.38$, $p = 0.072$, partial $\eta^2 = 0.06$, as No-PGD participants tended to show higher variance compared to the PGD-group. The repeated-measures factor was significant, $F(29,1508) = 2.12$, Huynh–Feldt corrected $p = 0.002$, because the variance increased across trials. The group × repeated measures interaction was not significant.

Third, the *serial cooperation shift measure* showed a significant effect of group, $F(1,52) = 5.27$, $p = 0.026$, partial $\eta^2 = 0.092$, as the PGD-group showed on average positive values, $M = 0.05$, $SD = 0.11$, while the No-PGD-group tended towards negative values, $M = -0.03$, $SD = 0.11$. This means that on average, PGD-patients' sharing increased from one turn to the next, whereas the opposite occurred in healthy controls. The overall repeated-measures factor was not significant, and the interaction of the repeated-measures factor with group was marginally significant, $F(28, 1456) = 1.53$, Huynh–Feldt corrected $p = 0.078$. The latter was mainly due to unexpected high sharing showed by participants in the No-PGD-group on trial 20, a planned defection trial which was followed by a drastic decrease in token sharing. This trial was the only planned defection trial (out of four) that was significantly different between the two groups (see Table 2). Notably, the significant group effect vanished when IIP-D scores were used as

TABLE 2 Results of the flexible iterated prisoner's dilemma

|	No-PGD-group (mean; SD)	PGD-group (mean; SD)	Test statistics
Mean number of tokens shared	6.07 (1.83)	6.75 (1.51)	$t(52) = -1.49$, $p = 0.14$
Number of tokens shared in the initial turn (turn 1)	5.59 (2.10)	5.44 (2.03)	$t(52) = 0.26$, $p = 0.79$
Shift after turn 12	−0.30 (5.23)	−0.67 (2.62)	$t(52) = 0.33$, $p = 0.74$
Shift after turn 20	−2.56 (3.79)	0.41 (3.60)	$t(52) = -2.95$, $p = 0.005$
Shift after turn 23	0.07 (4.68)	−0.41 (4.09)	$t(52) = 0.40$, $p = 0.69$
Shift after turn 27	−0.56 (3.04)	−1.07 (3.62)	$t(52) = 0.57$, $p = 0.57$
Number of tokens shared in the final turn (turn 30)	4.85 (3.42)	6.74 (3.13)	$t(51.62) = -2.12$, $p < 0.05$
Total profit	1130.15 (32.84)	1119.67 (27.02)	$t(52) = 1.28$, $p = 0.21$
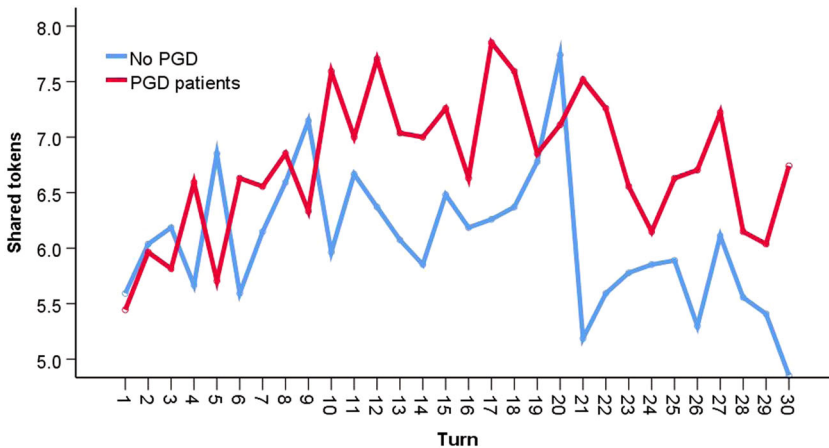
FIGURE 1 Mean giving on each turn for the two groups. Black lines indicate planned defection turns when the confederate player gave 0 tokens, regardless of what the participant had given on the prior trial

covariate in the ANOVA, $F(1,51) = 1.46$, $p = 0.23$, suggesting that interpersonal problems mediate the group difference in shifting cooperation.

Results of the posttask questionnaire indicate that the confederate players were found equally nice (No-PGD-group $M = 7.62$, SD = 2.34 vs. PGD-group $M = 7.58$, SD = 2.61), and both groups found the game equally interesting (No-PGD-group $M = 4.74$, SD = 3.17 vs. PGD-group $M = 4.88$, SD = 2.70). It was significantly more important to the PGD-group to achieve a maximum payoff for both parties (No-PGD-group $M = 3.96$, SD = 3.32 vs. PGD-group $M = 6.54$, SD = 2.87; $t(50) = -2.99$, $p > 0.01$).

4 | DISCUSSION

4.1 | Interpretations and conclusions

The current study investigated interpersonal problems and cooperative behavior in a sample PGD patients in comparison to bereaved healthy control participants. In line with our hypothesis, results show a significant difference between the two groups when it comes to interpersonal problems. Participants belonging to the PGD-group reported significantly more interpersonal problems overall, indicating that the PGD-group is more likely to be impaired by interpersonal problems (Horowitz et al. 2003). Although significant differences could be obtained for all subscales, the numerically highest scores could be found for the subscales overly accommodating (JK), socially inhibited (FG), nonassertive (HI), and self-sacrificing (LM). These subscales are associated with submissive and mostly friendly/warm behavior within the interpersonal model and have in common that individuals scoring high in these subscales often are either socially avoidant or try to please others (Horowitz et al. 2003).

In the FIPD that we employed to tap into interactive cooperation, the PGD-group showed behavioral differences to the No-PGD-group. Although mean number of tokens shared was not significantly different for the two groups when all turns were considered (including the initial phase of the game), the PGD-group tended to allow more cooperation to develop over time, regardless of the unforeseen (and relatively gross) planned defections that occurred. By comparison, the No-PGD-group behaved more carefully, as indicated by a negative overall shift value, a tendency towards higher decision variation (presumably reflecting higher reciprocation), and by the drastic withdrawal of cooperation in response to the

second of the planned defection turns, after which cooperation did not recover. Thus, the PGD-group showed lower responsiveness in the game.

Combined with the results obtained from the IIP-D, it could be argued that the cooperation behavior in the FIPD is the result of warm-submissive behavior and the underlying will to please others, however, interpreting the group × repeated measures interaction, which demonstrated that the number of shared tokens tended to be distributed differently across the 30 trials for the two groups, could also indicate a lack of *social flexibility* (Nelson & Guyer 2011) due to deficient valuation, inhibition, or rule use. Without further evidence, we suggest that valuation may be most deficient in PGD, leading to stronger commitment, higher dependency, and a higher than normal tendency to feel *fused* with the bereaved, as shown by other studies (Harrison et al. 2021). Hence, in persistently over-valuating the other, they might lack the capability to adapt to changes in the relationship. Interestingly, the significant differences between patients and controls in both, the cooperation shift measure, and in the number of tokens shared on the final turn, rendered insignificant when interpersonal problems as reported in the IIP-D were considered as a covariate in the analysis. This suggests that interpersonal problems had mediated the distinctive behavior of the patients in the game.

4.2 | Clinical implications

Our findings highlight the importance of interpersonal problems and cooperative behavior in PGD. As for now, most PGD-specific treatment relies on cognitive restructuring and/or exposure (Boelen et al. 2007; Bryant et al. 2014), but does not address interpersonal problems. Yet, addressing these problems, and filling the social void created by the interpersonal loss, will aid the adaptive grieving process and facilitate meaning reconstruction (Maciejewski et al. 2022). However, in order develop new or improve old relationships bereaved new to (re-)learn and practice interpersonal skills. Employing interpersonal effectiveness skills from Dialectical behavioral therapy has proven to be effective in general, as well as in PGD (Barrett et al. 2017; Linehan et al. 2006). In addition to that, the application of the cognitive behavioral analysis system of psychotherapy, where difficulties in interpersonal interactions are systematically analyzed, and alternative and more goal-directed behaviors acted out in roleplays, could be another interesting approach (McCullough 2003).

4.3 | Limitations and future implications

Our results should be interpreted with caution as there are some limitations. First, the cross-sectional design does not warrant for causal interpretations of our findings. Furthermore, our sample size was small and mainly consisted of female participants. There is a certain risk of chance findings. The sample size emanates from the application of very strict criteria for PGD. At the time when the study was designed in 2017, the official ICD-11 criteria had not been introduced yet; therefore, we decided to apply the stricter consensus criteria (Prigerson et al. 2009). These criteria resemble those of ICD-11, but instead of just one accompanying criterion, five are required. However, this approach guaranteed that our sample consisted of clinically impaired individuals, whilst previous studies in the field of PGD often did not do so (Killikelly & Maercker 2018). In a similar vein, we were also very strict when it came to the No-PGD-group, as participants were excluded if they had a history of any mental disorder past or present. Therefore, it could be argued that the No-PGD sample is "too healthy" and does not represent an average control sample. While the diagnostic process for both groups was very detailed and possible comorbidities have also been assessed, the high percentage of comorbid depression in the PGD-group could be criticized, implying that findings might also be the result of symptoms of depression. This criticism has to be acknowledged, as it is justified, yet comorbidity has proven to be generally high in PGD, with only 25% of those meeting the criteria for PGD not meeting the criteria for any other mental disorder (Simon et al. 2007). Thus, it could be argued that with 70% of the

PGD-group fulfilling the criteria for at least one other mental disorder, our study contains ecological validity. The results concerning interpersonal problems are based on a self-report questionnaire, whose interpretation is difficult. The developers of the questionnaire have indeed suggested that low total scores need not reflect low interpersonal problems per se, but might also indicate lack of awareness of these problems (Horowitz et al. 2003). This might be the case in the No-PGD-group participants who reported very low levels of interpersonal problems. Moreover, it would have been very interesting to include a measure of perceived social support, which would have enabled a direct investigation of the association between interpersonal problems and cooperative behavior (Rodebaugh et al. 2013).

Future research replicating the study with a larger, culturally more diverse sample, and equal proportions of male and female participants could help to understand the role of interpersonal problems and cooperation in PGD, especially in a longitudinal design. Future studies should apply the new criteria and would benefit from the inclusion of a depressed control group. We further propose the assessment of social support to receive a more fine-grained picture of how these factors can be associated with interpersonal problems and cooperation and have an impact on the development and maintenance of PGD.

Although the evidence was small and preliminary in the present case, we maintain that paradigms from behavioral economics represent a feasible approach that allows for the objective observation and evaluation of social behavior in group settings under controlled conditions. Thereby, difficulties in specific social settings or general impairments in social behavior can be disclosed. These circumstances make economic games especially interesting for clinical research as observed difficulties between ill and healthy subjects might aid the understanding of the etiology and maintenance of certain disorders, eventually stimulating research for novel treatment strategies (Clark et al. 2013; King-Casas & Chiu 2012; Wischniewski et al. 2009).

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICS STATEMENT

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of the Faculty Psychology and Sports Science Goethe University, Frankfurt (May 19, 2018, No. 2018-18). Informed consent was obtained from all individual participants included in the study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1002/jclp.23340.

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