Title: The dyadic effects of Type D personality on health in romantic couples

Short title: *Actor and partner effects of Type D on health*

Abstract

Objective: An individual's own personality traits are powerful predictors of their health outcomes (actor effects). However, the effect of personality on health may also occur at an interpersonal level, whereby the personalities of people close to the individual also affect his or her health outcomes (partner effects). Our objective was to examine the actor and partner effects of Type D personality on health in romantic couples for the first time.

Design: Cross-sectional questionnaire-based study (N=364), consisting of 182 romantic couples from the general population (mean age 35.7 years).

Main Outcome Measures: Each participant completed self-report measures of Type D personality (DS14), health behaviours (GPHB), mood (DASS-21) and quality of life (WHOQOL-BREF).

Results: Data were analysed using the Actor-Partner Interdependence Model (APIM). The APIM showed no actor or partner effects of the overall Type D construct. However, there were actor effects of negative affect for both males and females on depression and quality of life, a male actor effect of social inhibition on quality of life, and a female partner effect of social inhibition on depression.

Conclusions: These findings suggest that there are both actor and partner effects of the Type D components on some health outcomes.

Keywords: Type D personality; Actor-partner interdependence model; romantic relationships; health behaviour; quality of life; mood

An individual's personality can have an important impact on their health and longevity (Friedman, Kern, & Reynolds, 2010). One personality construct that has received considerable recent interest is Type D (distressed) personality (Kupper & Denollet, 2018). Type D refers to the combination of negative affectivity and social inhibition (Denollet, 2005). Meta-analyses report a robust association between Type D and poor prognosis in patients with coronary artery disease (Grande, Romppel, & Barth, 2012; Versteeg et al., 2012), including a doubled risk of adverse events and mortality. Type D has also been associated with poorer health in the general population (Mols & Denollet, 2010), including engaging in fewer health-beneficial behaviours (Williams, Abbott, & Kerr, 2016), and higher levels of physical health complaints and subjective stress (Smith et al., 2018a; Allen, Wetherell, & Smith, 2019). However, no studies have addressed the interpersonal effects of Type D personality on health, whereby the personalities of people close to us affect our health. The current study addresses this by examining the actor and partner effects of Type D personality on health outcomes for the first time.

Most studies on the link between personality and health assume that it is an individual's own personality that influences their health (i.e. that the relations are intrapersonal). However, it has also been posited that the effects of personality may occur at an interpersonal level whereby the personalities of those close to us (e.g. our romantic partners) may also influence our outcomes (Zayas, Shoda, & Ayduk, 2002; Shoda et al., 2002). Zayas et al. outline a personality-in-context framework, which suggests that our thoughts, emotions and behaviours are the product of the interpersonal system that we are part of, rather than solely the result of our own personality. Ferguson (2013) also highlighted the importance of investigating the effects of personality (including Type D) on health within a multi-level framework, considering individual, group and organisational levels. Analysis at a group level includes dyadic interactions, comprising doctor-patient and spouse/carer-patient dyads. Ferguson (2013) suggests that within dyads, one partner's personality can act as a protective or risk factor for their partner's health.

Analysis of dyadic data is typically performed using the actor-partner interdependence model (APIM; Kenny, 1996; Kenny, Kashy, & Cook, 2006). The APIM provides a way for the association between a predictor and outcome variable for members of a dyad to be broken down into two distinct pathways. The first pathway is referred to as the actor effect and represents the unique effect of a person's own predictor on his or her own outcome. The second pathway is referred to as the partner effect and represents the unique effect of that person's predictor on their dyadic partner's outcome.

Research on the Big Five supports the contention that the personality traits of one's partner can predict health outcomes. Roberts et al. (2009) conducted one of the first studies to examine such partner effects of the Big Five. They investigated the link between an individual's level of conscientiousness, their spouse's level of conscientiousness, and an individual's self-rated health in a sample of older participants. They found that those with partners with higher levels of conscientiousness reported better subjective health and fewer physical limitations. The authors referred to this effect as compensatory conscientiousness, as partner conscientiousness predicted health outcomes above and beyond the individual's own level of conscientiousness. Nickel, Iveniuk and Roberts (2017) recently replicated these results. Similar findings have been observed for other personality constructs, with partner optimism predicting better physical functioning and fewer chronic illnesses in older adults (Kim, Chopik, & Smith, 2014). More recently, Gray and Pinchot (2018) examined both the actor and partner effects of the Big Five on general health as part of the British Household Panel Survey. They found partner effects for neuroticism, which was associated with poorer partner health, and for extraversion, which was associated with better partner health.

The current study examined the partner effects of Type D personality for the first time. Although previous research has examined the partner effects of neuroticism and extraversion, constructs that have some overlap with the Type D traits of negative affect (mean r = .74) and social inhibition (mean r = −.63) respectively (Horwood, Anglim, & Tooley, 2015), no study has examined the partner effects associated with the synergy of

these traits, delineated by Type D. Despite the overlap between Type D and neuroticism/extraversion, previous research has shown that there are qualitative differences between the social inhibition trait and extraversion, with the social inhibition trait of Type D focusing more on the interpersonal dimension of introversion (i.e. withdrawal and low self-expression) rather than the intrapsychic (i.e. energy and excitement seeking) dimension (De Fruyt & Denollet, 2002). In addition, the NA component of Type D is more strongly related to the facets of neuroticism that represent negative emotional tendencies, such as anxiety, depression, and anger than it is with the facet of impulsiveness, which is more reflective of difficulties in self-control (Horwood, Anglim, & Tooley, 2015).

We predicted that having a partner who possesses high levels of Type D may have a deleterious effect on one's own health. There are a number of reasons why we expected this to be the case. First, Type D is associated with depressive symptoms, and previous research has shown the negative effects of a partner's level of depressive symptoms on the other partner's quality of life (Chung et al., 2009). Second, Type D is associated with poor social relationships reflected by lower levels of social support (Williams et al., 2008); we expected Type D partners to provide their partners with less social support, which can have a negative impact on health. Third, Type D is associated with poorer health-related behaviours. Evidence suggests that people tend to exhibit the same health behaviours as those around them. This is particularly evident within couples where concordance has been demonstrated for behaviours such as alcohol consumption and physical activity (Wilson, 2002).

In the current study, we examined the partner effects of Type D on the following outcomes: quality of life, health behaviours, depression, anxiety, and stress. These outcomes were selected as they have all been consistently associated with Type D in studies utilising a general population sample (Mols & Denollet, 2010). There is some debate in the Type D field regarding the best way to conceptualise the construct. Ferguson et al. (2009) demonstrated through taxometric analyses that Type D is better represented as a

dimensional rather than a categorical construct. Consequently in the current study, we followed the procedure outlined by Ferguson et al. (2009) and conceptualised Type D as a continuous construct, by utilising the interaction term of negative affect and social inhibition. Accordingly, the current study examined the actor and partner effects of Type D personality, negative affect, and social inhibition on quality of life, health behaviours, and mood.

Method

Participants

One hundred and eighty-two romantically involved heterosexual couples took part in the study, with an age range of 18-78 (*M* = 35.7, *SD* = 12.79). Our inclusion criteria was that couples had to have been in a relationship for a minimum of six months. Just under half the sample were married (47%), and the majority of couples (79%) lived together. The mean length of relationship was 10 years and 9 months (*M* = 131.2 months, *SD* = 121.11).

Measures

Type D Personality

The Type D Scale (DS14) was used to assess Type D personality (Denollet, 2005). The scale consists of 14 items comprising two subscales. One subscale assess levels of negative affectivity (NA), e.g. 'I often find myself worrying about something', and the other subscale assesses levels of social inhibition (SI), e.g. 'I would rather keep other people at a distance'. Responses are made on a five-point scale ranging from 0 (false) to 4 (true) giving a score between 0 and 28 for each subscale. Originally, Type D was utilised as a dichotomous typology, with the classification of Type D established by the participant scoring above established cut-off point (>10) for both NA and SI subscales, but this has been the subject of criticism and scrutiny (Coyne et al., 2011; De voogd, Sanderman, & Coyne, 2012;

Ferguson et al., 2009; Smith, 2011). In addition, Maxwell and Delaney (1993) expressed concern about the likelihood of spurious results when a typological construct, like Type D, is created from two dichotomised variables. Based on their taxometric analysis, Ferguson et al. (2009) suggested that Type D is better represented as a continuous variable, as the multiplicative interaction terms of NA × SI, than as a dichotomous variable. It is then possible to determine if the multiplicative interaction of NA and SI predicts outcome after controlling for the main effects of the NA and SI. Denollet has proposed that the Type D consists of more than just the presence of negative emotions and that SI is a moderator of the effects of NA on outcome (Denollet, 2005). Accordingly, the interaction of NA × SI should predict outcome above and beyond the effects of NA and SI independently, if it is the synergistic effect of the constructs that is key. In the present study, we utilised Type D as a continuous measure, whereby an individual's NA score was multiplied by their SI score in order to give a total Type D score. This method of delineating Type D has been utilised to overcome the limitations of the traditional categorical approach of classifying Type D (Ferguson et al., 2009), and has been widely used in Type D research (e.g. Smith et al., 2018b; Stevenson & Williams, 2014). Both subscales demonstrated good internal consistency (NA: α = .83, SI: α = .83) in the present study.

Health Behaviours

The General Preventive Health Behaviours Checklist (Amir, 1987) is a checklist of health behaviours (e.g. 'eat sensibly', 'get enough exercise', 'get enough sleep'). Participants are asked to state how often they engage in each behaviour using the response options of 0 ('no, do not do'), 1 ('sometimes'), and 2 ('yes, always or almost always'). Responses are summed and higher scores indicate greater engagement with healthy behaviours. Cronbach's α=.76 indicating good levels of internal consistency in the current study.

Quality of Life

The World Health Organisation's Quality of Life Questionnaire (WHOQOL-BREF; The WHOQOL Group, 1996) is a 26-item measure of a participant's quality of life across different domains. These domains are physical (e.g. 'to what extent do you feel that physical pain prevents you from doing what you need to do?'), psychological (e.g. 'how often do you have negative feelings such as blue mood, despair, anxiety, depression?'), social relationships (e.g. 'how satisfied are you with the support you get from your friends?'), and environment (e.g. 'how satisfied are you with the conditions of your living place?'). Participants answer on a 5-point Likert scale, with higher scores reflecting better quality of life. Cronbach's $\alpha = .87$, indicating high internal consistency for the overall scale in the present study.

Depression, Anxiety and Stress

The Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a 21-item measure of mood, consisting of 7 items per subscale of depression (e.g. 'I felt that I had nothing to look forward to'), anxiety (e.g. 'I felt I was close to panic') and stress (e.g. 'I found it hard to wind down'). Responses were made on a 4-point Likert scale ranging from 0 to 3, representing 'never', 'sometimes', 'often' and 'almost often', with higher scores indicating higher levels of negative emotions. The DASS-21 demonstrated good internal consistency in the present study (depression: $\alpha = .84$, anxiety: $\alpha = .78$, stress: $\alpha = .80$).

Procedure

Ethical approval was obtained from the lead author's institutional ethics committee. Participants were members of the general public, recruited in couples from visitor attractions in Scotland including Glasgow Science Centre and the Edinburgh Royal Botanic Garden. The researchers approached potential participants in order to establish if they met the inclusion criteria. Once it was established that participants did meet the inclusion criteria they were asked to read an information sheet and complete a consent form. Each member of the

couple was then given a questionnaire to complete separately from their partner, in the presence of the researcher. Participants were instructed not to discuss their answers with their partner. Participants were debriefed on completion of the questionnaire and matching codes were written on the couple's questionnaires in order to link their data as members of a dyad. No monetary incentive or reward was given for participation.

Statistical Analysis

First, correlation analyses were performed in order to examine the associations between actor and partner personality factors and health outcomes. Second, we utilised the APIM in order to model the dyadic relationships between variables and examine the influence of a person's own personality on their own health (actor effect), and the influence of the person's personality on their partner's health (partner effect). APIM uses the entire dyadic sample and so each participant is treated as both an actor and partner. The APIM analysis was carried out on AMOS (v24) using full-information maximum likelihood (FIML) to handle missing data. We used distinguishable dyads whereby gender was used as the distinguishing factor. Personality factors were entered as the predictors and health behaviours, mood, and quality of life as the outcome variables. Age and marital status (dummy coded as 1=married; 2=not married) were entered as covariates. Type D variables (NA and SI) were mean centered for use as IVs as well as for the interaction term (NA x SI). The APIM for the effects of Type D on depression is shown in Figure 1 as an example of how the analyses were conducted. All other APIM analyses followed the same format. Age and marital status was controlled for in all models.

Insert Figure 1 here

Results

Correlation analysis – Type D actor effects

Correlations and descriptive statistics for Type D personality and health outcomes are presented in Table 1. In terms of actor effects, there were significant associations between an individual's own Type D personality and their own health outcomes for both males and females. Higher levels of Type D personality were associated with higher levels of depression, anxiety and stress in males and females. In addition, high Type D was associated with poorer quality of life in males and females. No correlation was found between Type D and health behaviours in males, but in females higher Type D was associated with performing less healthy behaviours. For the Type D components, NA was associated with higher depression, stress, and anxiety in males and females, as well as lower quality of life. In females, high NA was also associated with lower health behaviours. SI was positively associated with depression and stress, and negatively associated with quality of life in both males and females, as well as lower health behaviours and higher levels of anxiety in females.

Correlation analysis – Type D partner effects

In terms of partner effects, there were no significant associations between a male partner's Type D score and their female partner's health outcomes. However, higher levels of Type D in the female partner were significantly associated with lower quality of life in their male partner. In addition, when examining the constituent elements of Type D (i.e. NA and SI), higher levels of SI in the female partner were associated with significantly higher levels of depression in their male partner. No other significant associations were observed for NA and SI on partner health outcomes.

APIM analyses

As the correlation analysis found a significant correlation between a female partner's Type D and their male partner's quality of life, and a significant correlation between a female partner's SI and their male partner's depression, we performed two APIM analyses to further test these effects. The APIM analysis for the effects of Type D on quality of life is shown in Table 2. In this analysis we examined the actor and partner effects of Type D (NAxSI) as well as NA and SI on their own. The analyses demonstrated significant male (β=-.40, p<.001) and female (β=-.51, p<.001) actor effects of NA on quality of life, and a significant male actor effect of SI (β =-.15, p<.05) on quality of life. There were no partner effects of NA, SI, or Type D on quality of life. In addition, there was no effect of age, but there was a significant effect of marital status on male quality of life (β= -.17, p<.05) whereby males who were married reported better quality of life. When analysing depression, there were also significant male (β=.61, p<.001) and female (β=.47, p<.001) actor effects of NA on depression. There was also a female partner effect of SI (β =.15, p<.05) There was no effect of age, or partner NA or Type D, but marital status did have a significant effect on female depression (β =.16, p<.05), whereby females who were married had lower levels of depression.

Insert Table 2 here

Discussion

The present study is the first to examine the actor and partner effects of Type D on health behaviours, mood, and quality of life. The correlation analysis demonstrated that an individual's own level of Type D was associated with higher levels of depression, anxiety, and stress. These relationships have been established previously in both cardiac patients and the general population. Recently, Allen, Wetherell, and Smith (2019) identified higher levels of depression, anxiety and stress in Type D individuals, and Smith et al. (2018a) showed that the relationship between Type D and physical symptoms can be explained by

subjective stress and anxiety. We also found that Type D is associated with poorer quality of life. Again this is consistent with previous research which has shown that Type D predicts poorer quality of life in cardiac patients (Denollet, Vaes, & Brutsaert, 2000). Finally, Type D was associated with poorer health behaviours in females. Previous research has shown that Type D individuals engage in fewer health behaviours (Williams et al., 2008).

Our study is the first to examine partner effects of Type D on health. The correlation analysis showed no significant associations between a male partner's Type D score and their female partner's health outcomes. However, higher levels of Type D in the female partner were significantly associated with lower quality of life in their male partner. In addition, when examining the constituent elements of Type D, higher levels of SI in the female partner were associated with significantly higher levels of depression in their male partner. The APIM showed that there were no actor or partner effects of the overall Type D construct (NAxSI) on any of the outcomes. However, when we examined the Type D components separately we found significant male and female actor effects of NA on quality of life, and a male actor effect of SI. There were also significant male and female actor effects of NA on depression, and a significant female partner effect of SI on depression. Therefore, although there were no partner effects of the global Type D construct, there was a female partner effect for SI on depression.

In the current study, we followed the procedure outlined by Ferguson et al. (2009) and conceptualised Type D as a continuous construct, delineated by the interaction term of NA and SI. Traditionally, Type D was utilised as a categorical construct where participants had to score ≥10 on both the NA and SI subscales to be classified as Type D. More recently, Denollet and colleagues have adopted a similar approach of using these thresholds to create four groups, rather than two (i.e. Type D personality, high NA only, high SI only, and a reference group) (e.g. Spek et al., 2019). However, Ferguson et al. (2009) have argued, using taxometric procedures, that Type D should not be conceptualised as a categorical construct and that the cut-off points are arbitrary. Instead, they recommend conceptualising

Type D as a dimensional construct, an approach that has been used in a number of recent studies (e.g. Smith et al., 2018b; Allen, Wetherell, & Smith, 2019; Stevenson & Williams, 2013).

A consequence of utilising Type D as a continuous construct it that it is possible to control for the main effects of the constituent elements of Type D (NA and SI) during analysis. We can therefore determine if the multiplicative interaction of NA and SI is associated with the outcome after controlling for the main effects of the NA and SI. Doing so in the APIM in the current study suggested that there were no actor or partner effects of the overall Type D construct (NAxSI) on any of the outcomes. However, there were actor effects of NA on quality of life and depression and a female partner effect SI on depression. Similarly, Stevenson and Williams (2014) found that NA x SI did not predict quality of life and physical symptoms, but that NA did. Recently a study by Allen et al. (2019) also found that the NA x SI interaction did predict symptoms after controlling for the influence of the NA and SI components, but that this effect was marginal, suggesting that the effects may be primarily driven by NA. The current study adds to these findings and suggests that for quality of life and depression, NA and SI may be more important independently, rather than in interaction with one another. However, it is important to note that the predictive utility of NA, SI and NA x SI may differ in different populations and for particular outcome measures, with Kupper and Denollet (2016) demonstrating that the risk conferred by Type D can be modulated by age and choice of endpoint.

The only partner effect that was observed in the current study was a female partner effect of SI on male depression. This finding indicated that for males, having a female partner who is more socially inhibited was associated with them having higher symptoms of depression. One potential explanation for this finding is that high social inhibition levels in one partner may drive socially avoidant behaviour in the couple, thus limiting opportunities for social interactions.

The present study has several limitations. First, this was a cross-sectional study and so does not provide any information on the changes that may occur over time in the relationship between personality and health or whether partners may exert more of an influence at different stages of a relationship. The present study is also limited by its use of self-report measures of health outcomes. The inclusion of more objective measures of health (e.g., blood pressure) or more objective measures of health behaviours (e.g., accelerometers to assess physical activity) would have provided a more objective measure of health outcomes. Finally, the sample was based on male-female couples who are relatively young (mean age= 35.7 years), meaning that we cannot drawn any conclusions about the partner effects of personality in same-sex couples or in older adults. Future research should therefore adopt prospective investigations of the relationship between partner personality and health, and include objective measures of health outcomes. It would also be of interest for future research to consider if there may be different partner personality effects as a couple ages. Roberts at al. (2009) have previously suggested that personality effects may be different in older rather than younger couples. Older couples will likely have lived together for longer and so the partner effects of personality may be stronger. In addition, older couples are likely to face more health problems than younger couples, and so a partner's support may become more important as a couple ages.

The current study was the first to examine partner effects of Type D on health. We found that there were no partner effects of the global Type D construct on health, but that there were actor effects of NA for males and females on depression and quality of life, along with a male actor effect of SI on quality of life and a female partner effect of SI on depression. These findings demonstrate that NA is the component of Type D most associated with an individual's own levels of depression and quality of life, and that for males, having a female partner high in SI has a negative effect on their levels of depression.

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Table 1: Descriptive statistics and correlations for Type D personality and health outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Male NA	-	.309**	.778**	.013	.032	.028	-.211	.059	.630**	.032	.381**	-.061	.676**	-.087	-.444**	.009
2. Male SI		-	.773**	-.006	-.004	.001	.039	.085	.225**	-.029	.122	-.016	.252**	-.008	-.262**	-.027
3. Male Type D			-	-.004	.019	.033	-.115	.075	.510**	.018	.311**	-.073	.549**	-.052	-.446**	-.019
4. Female NA				-	.408**	.719**	-.049	-.332**	.062	.502**	-.001	.337**	-.002	.622**	-.142	-.546**
5. Female SI					-	.877**	.096	-.201**	.173*	.295**	.107	.182*	.092	.247**	-.128	-.334**
6. Female Type D						-	.023	-.287**	.149	.442**	.059	.269**	.068	.455**	-.184*	-.494**
7. Male HB							-	.236**	-.256**	-.095	-.150*	-.008	-.169*	-.072	.335**	.140
8. Female HB								-	.009	-.274**	-.096	-.206**	.039	-.407**	.097	.411**
9. Male dep									-	.190*	.530**	.031	.663**	.043	.641**	-.128
10. Female dep										-	.131	.524**	.160*	.645**	-.236**	-.524**
11. Male anx											-	.144	.611**	.074	-.445**	-.120
12. Female anx												-	.040	.640**	-.048	-.380**
13. Male stress													-	.032	-.466**	-.084
14. Female stress														-	-.137	-.514
15. Male QoL															-	.290**
16. Female QoL																-
M	10.18	11.18	122.70	12.04	9.26	123.06	31.17	32.29	6.54	6.06	5.06	6.34	10.66	12.26	95.42	93.60
SD	5.49	5.74	102.88	5.13	5.35	95.85	6.76	6.98	6.60	6.85	6.05	6.94	7.36	8.16	10.38	11.24

Note: * p<.05, ** p<.01

Table 2. Actor and Partner Effects of Type D on health outcomes

Effect	**Standardised Beta**
NA → Quality of Life (Male Actor)	-.40**
NA → Quality of Life (Female Actor)	-.51**
SI → Quality of Life (Male Actor)	-.15*
SI → Quality of Life (Female Actor)	-.12
Type D → Quality of Life (Male Actor)	-.09
Type D → Quality of Life (Female Actor)	-.06
NA → Quality of Life (Male Partner)	.03
NA → Quality of Life (Female Partner)	-.14
SI → Quality of Life (Male Partner)	-.04
SI → Quality of Life (Female Partner)	-.05
Type D → Quality of Life (Male Partner)	-.03
Type D → Quality of Life (Female Partner)	-.10
Marital Status → Male Quality of Life	-.17*
Marital Status → Female Quality of Life	.00
NA → Depression (Male Actor)	.61**
NA → Depression (Female Actor)	.47**
SI → Depression (Male Actor)	.04
SI → Depression (Female Actor)	.10
Type D → Depression (Male Actor)	-.02
Type D → Depression (Female Actor)	.04
NA → Depression (Male Partner)	.03
NA → Depression (Female Partner)	-.01
SI → Depression (Male Partner)	-.01
SI → Depression (Female Partner)	.15*
Type D → Depression (Male Partner)	.04
Type D → Depression (Female Partner)	.00
Marital Status → Male Depression	-.02
Marital Status → Female Depression	.16*

Note * p<.05, ** p<.001

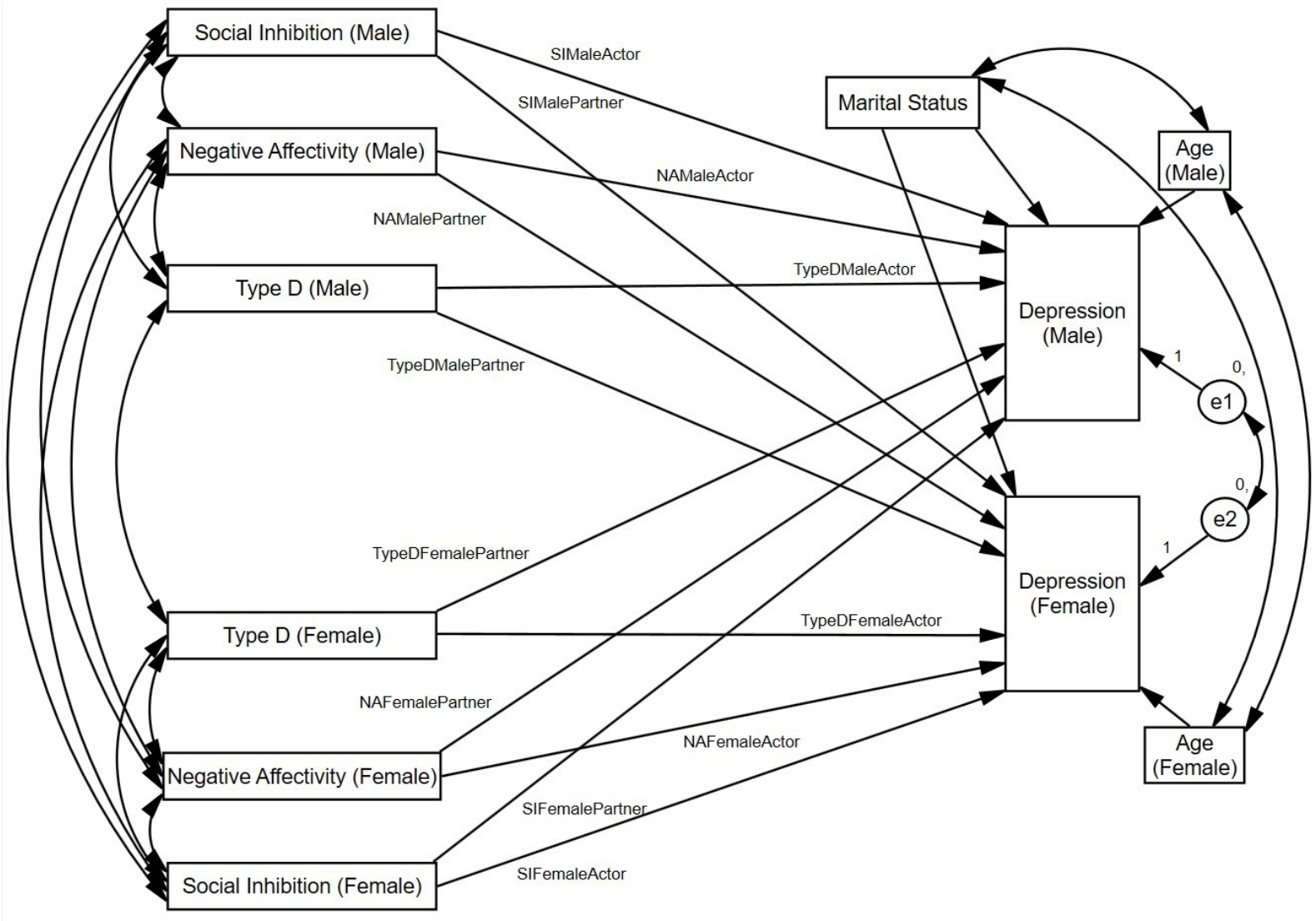

Figure 1. Example of APIM analysis conducted