Is type-D personality trait(s) or state? An examination of type-D temporal stability in older Israeli adults in the community.

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Background: Type-D personality was suggested as a marker of poorer prognosis for patients of cardiovascular disease. It is defined by having a score of 10 or more on both sub-scales of the DS14 questionnaire, Social Inhibition (SI) and Negative Affect (NA). As Type-D was designed to predict risk, its temporal stability is of prime importance. Methods: Participants in the current study were 285 community volunteers, who completed the DS14, and other personality scales, at a mean interval of six years. Results: The prevalence of Type-D did not change. The component traits of Type-D showed rank order stability. Type-D caseness temporal stability was improved by using the total DS14 score. Using the scale's product as a criterion further improved temporal stability. Logistic hierarchical regression predicting Type-D classification from Time1 demonstrated that the best predictors were Time1 scores on NA and SI, with the character trait of Cooperation, and the alexithymia score adding some predictive power. Conclusions: Temporal stability of Type-D caseness may be improved by using a sum or product threshold, rather than the current rule. In any case, as the temporal stability of Type-D is limited, research is required to formulate the optimal timing for Type-D measurement for predictive purposes.

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3 **Older Israeli Adults in the Community**.

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19 Running head: Temporal stability of Type-D personality

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ABSTRACT

Background: Type-D personality was suggested as a marker of poorer prognosis for patients of cardiovascular disease. It is defined by having a score of 10 or more on both sub-scales of the DS14 questionnaire, Social Inhibition (SI) and Negative Affect (NA). As Type-D was designed to predict risk, its temporal stability is of prime importance. Methods: Participants in the current study were 285 community volunteers, who completed the DS14, and other personality scales, at a mean interval of six years. Results: The prevalence of Type-D did not change. The component traits of Type-D showed rank order stability. Type-D caseness temporal stability was improved by using the total DS14 score. Using the scale's product as a criterion further improved temporal stability. Logistic hierarchical regression predicting Type-D classification from Time1 demonstrated that the best predictors were Time1 scores on NA and SI, with the character trait of Cooperation, and the alexithymia score adding some predictive power. Conclusions: Temporal stability of Type-D caseness may be improved by using a sum or product threshold, rather than the current rule. In any case, as the temporal stability of Type-D is limited, research is required to formulate the optimal timing for Type-D measurement for predictive purposes.

Type-D, "distressed" personality type is characterized by high negative affect, coupled with elevated social inhibition, making the Type-D person unable to gain adequate social support for the weight of negative affect he or she experiences (Denollet, 2005). Individuals with Type-D personality are more likely than others to suffer from social anxiety (Kupper & Denollet, 2014). Measured by a self-report questionnaire (DS14; Denollet, 2005) Type-D is classified when respondents score 10 or more on each of the component traits, social inhibition (SI) and negative affect (NA). Type-D personality has been found to be a potent risk factor for hypertension and for cardiac vascular disease (Strike & Steptoe, 2005). One mechanism putting Type-D individuals at risk is thought to be that high levels of chronic stress lead to high concentrations of stress hormones, harming the membranes of blood vessels and allowing the build-up of plaque, which in turn raises blood pressure and makes cardiac events more likely. There is some proof of causality; not only does Type-D personality raise the probability of cardiac vascular disease (CVD), but addressing the distress of Type-D personality patients after a cardiac event leads to significantly lower mortality and morbidity (Denollet & Brutsaert, 2001). Another possible mechanism is that Type- D individuals may engage in less healthy behavior. A study of patients with heart failure in the United States (Wu & Moser, 2013) found that Type-D patients were less likely to adhere to their medication. Indonesian coronary heart patients who were Type-D engaged less in health behavior than Non-D patients (Ginting, van de Ven, Becker, & Näring, 2014). A study of Dutch patients attending an outpatient cardiac clinic (Schifferet al., 2005) showed that type-D personality tripled the risk of heart failure and increased the risk for depressive symptoms more than six-fold. A longitudinal study of over 500 cardiac patients (Denollet, Pedersen, Vrints & Conraads, 2013) found significant odds ratio for Type-D cardiac patients to suffer a major cardiac event (MACE), i.e. a myocardial infarction, coronary

revasculation, or cardiac death. These effects did not hold when using the component traits of Type-D, SI and NA as continuous risk factors and depended on the interaction, i.e. both traits being above a cut-off of 10. A meta-analysis of many smaller studies showed Type-D to confer additional risk or poorer prognosis for CVD patients (Grande, Romppel, & Barth, 2012). It should be noted that in some studies, depression is found to be a better prognostic predictor than Type-D status (e.g. Damen et al., 2013). In others, Type-D is not associated with poorer health behavior (Habibović et al., 2014).

These findings about Type-D show a strong effect, but the question whether or not Type-D personality is a discrete entity has yet to be addressed empirically. The features associated with Type-D, negative affect and social inhibition, can arise from multiple continuous traits with different psychological and biological causes. Moreover, if Type-D is a discrete entity, one would expect it to have high temporal stability.

Temporal stability has been variously defined. In trait-personality models, temporal stability is usually reported as the correlation of trait scores at different time-points, often called rank-order stability. This can be applied in the current study to the component traits of Type-D, NA and SI. However, this measure misses the essence of Type-D, i.e. that it is a dichotomous classification, and thus very different from most current personality models. To measure temporal stability of the Type-D dichotomous classification, two additional measures of temporal stability were considered: 1) the prevalence of Type-D individuals at both time-points, and 2) The proportion of individuals who were classified as Type-D at T1 who still qualified for type-D at T2; and the proportion of T1 non-D individuals who still qualified for Non-D status at T2. Since Type- D is defined by an absolute threshold (a score of 10 or more on both of the subscales), it was also possible to examine the temporal stability of the dichotomous

classification, by examining alternate definitions of "Dness": using a simple sum of the two subscale-scores, and examining temporal stability of the classification into Dness and Non-Dness at the two time-points; in addition, in keeping with the interactive nature of the original criterion (10 or more on both subscales) examining the criteria points provided by the product of NA and SI scores for temporal stability of this alternate classification.

The current study addresses the question of temporal stability of Type-D in a non-clinical sample of Israeli adult community volunteers, measured twice at a mean interval of six years. At outset, 1350 volunteers completed the DS14 (Zohar, Lev-Ari, Denollet and Cloninger, 2011). At that time, 24.1% of the participants were Type-D positive, and on average the Type-D group differed substantially from the Non-D group: they were more alexithymic, reported poorer subjective health, less social support and lower satisfaction with life. There was also a significant association between being Type-D positive and having a known medical diagnosis of CVD or diabetes. Individuals who were Type–D positive were significantly different from the Non-D individuals on six of the seven TCI traits: more harm avoidant, less novelty seeking, less reward dependent, less persistent, less self-directed and cooperative. A mean six years later about a quarter of the original sample were available for re-testing.

This study wished to examine the following questions: 1. The temporal stability of Type-D prevalence. 2. The rank-order stability of the component traits of Type-D, SI and NA. 3. The temporal stability of the Type-D classification using the accepted criterion. 4. Examining as threshold points the sum or the product of the sub-scale scores of the DS14 to see if they provide more stable classifications than the Type-D membership. 5. Using the extensive personality scales used at Time1 and described in detail elsewhere (Zohar, Denollet, Lev-Ari and Cloninger 2011) to add to the prediction of Time2 Type-D classification.

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METHOD

Participants

Participants were 285 community volunteers, enrolled in a longitudinal study of personality and health. The baseline sample is described in detail elsewhere (Zohar and Cloninger, 2011). In the current study only those participants who had previously agreed to take part in the longitudinal study, and who were still alive, and who had access to the internet were contacted. This included 471 potential participants. Comparing this subset to the original baseline sample on all personality and demographic variables showed that this subset did not differ from the baseline sample in any of the variables except mean age – this sample was on average about two years younger. Of those 471 contacted, 60.1%, or 285, completed the extensive on-line self-report which is the time 2 (T2) data. Of these, 42.4% were men. The participants' age ranged between 45 and 95, with a mean of 62.2. Their education ranged between partial primary school and Ph.D., with a mean of 15.75 years of education, i.e. college education. Most, 68.4% were married, 19.2% were divorced, and 8.4% were widowed. The final sample was comparable to the baseline sample on all personality variables.

Procedure

The baseline measurements were reviewed and approved by the ethics committee of the neighboring hospital, approval #42/2007. The second time point measurements were reviewed by the institutional IRB, who also approved the electronic informed consent procedure for the online self-report. Potential baseline participants were contacted by email, and those who agreed to participate in this phase of the study were mailed a link to an online questionnaire.

Measures

DS14 (Denollet, 2005): This 14 item questionnaire includes 7 items which measure negative affect (NA) and 7 items which measure social inhibition (SI). Type-D personality is confirmed when an individual scores 10 or more on both the subscales. The DS14 was found to perform very well in Hebrew (Zohar, Denollet, Lev Ari, & Cloninger, 2011). It showed structural validity in exploratory and confirmatory factor analyses, and convergent and divergent validity against other personality scales, in particular the temperament and character inventory, (TCI ; Zohar & Cloninger, 2011). There are 14 items in the DS14, each scored on a Likert-like scale 0-4. The two component traits, negative affect (NA) and social inhibition (SI) are each measured by 7 items.

TCI-140: This version of the Temperament and Character Inventory includes 140 items which are answered on a 5-value Likert-like scale. It measures four temperament traits: harm avoidance (HA); novelty seeking (NS); reward dependence (RD) and persistence (PS). In addition it measures 3 character traits: self-directedness (SD); cooperation (CO) and self-transcendence (ST). The TCI-140 performs very well in Hebrew (Zohar & Cloninger 2011).

Toronto Alexithymia Scale-20 (TAS20): Bagby, Parker & Taylor (1994) constructed a 20 item 5-point response scale for alexithymia which reduces to 3 subscales, difficulty in identifying feelings, difficulty in describing feelings, and externally-oriented thinking. A total score over 61 is considered evidence of alexithymia, and a total score of less than 51 is considered evidence for non-alexithymia (Taylor, Bagby & Parker, 1997).

Data Analysis

All data were entered directly onto SPSS via self-report using Qualtrics. Hypothesis testing was conducted using SPSS21.0 for WINDOWS. Only complete reports were considered in this study.

RESULTS

The potential score for each of the 14 items of the DS14 is 0 to 4. Thus for each of the sub-scales, the scale score ranges from 0 to 28. For SI the mean at T1 was 9.59 (SD=5.4) and at T2 9.04 (SD=6.7). For NA the mean at T1 was 8.96 (SD=5.3) and 8.76 (SD=5.8) at T2.

Type-D prevalence

In the original base sample (N=1350; Zohar, Denollet, Lev Ari, & Cloninger, 2011) the prevalence of Type-D was found to be 24.1%. A subset of the base sample who completed the T2 evaluation are presented in the current study. Of them 72 or 25.3% were Type-D at T1. A mean six years later, 62 of the 285 participants, or 21.4% were Type-D. The rates of Type-D at the various time-points are not different: Baseline vs. baseline-subset: χ^2 =0.1589, p>0.05; baseline-subset vs. Time2: χ^2=1.1867, p>0.05. Thus Type-D membership does not bias for or against continued participation in a longitudinal study; and the **prevalence** of Type-D personality is temporally stable.

Rank-order-stability of DS14 Traits

Rank-order stability of the DS14 subscale scores was assessed by calculating the correlation between the traits at T1 and T2. For SI, the correlation was 0.818, p<0.001. For NA it was 0.723, p<0.001.

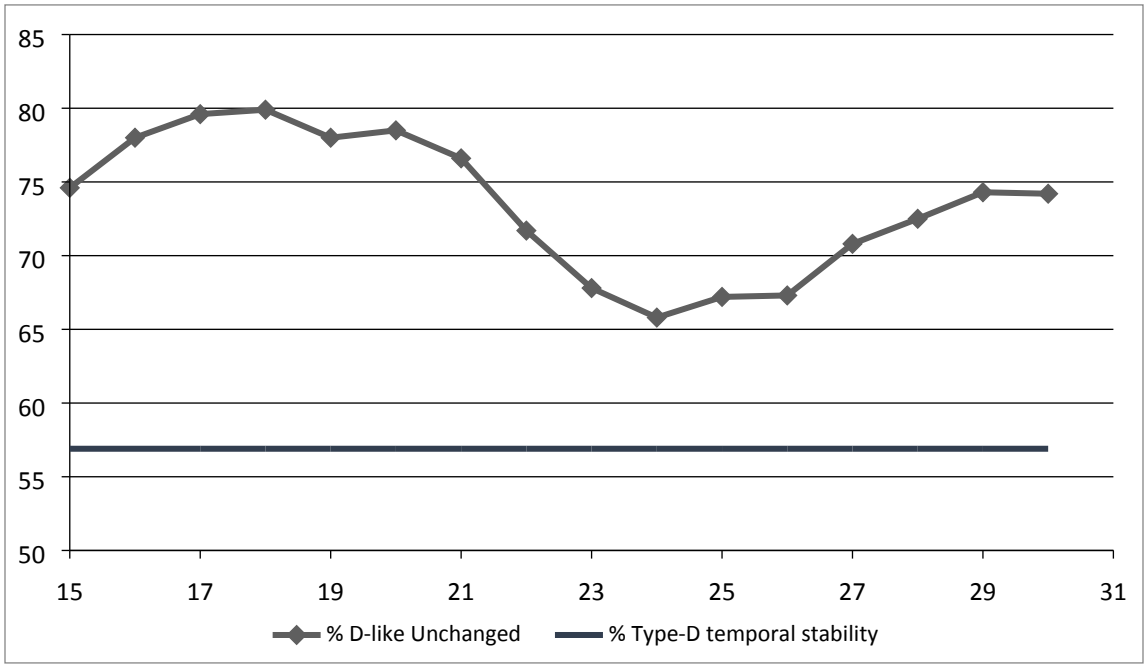
Type-D membership temporal stability

Were the same individuals who were classified as Type-D at T1 classified as Type-D at T2? This question was examined by cross-tabulating the 285 participants for Type-D classification at both time-points. The association between the classification at both time-points was strong: χ^2=72.34, p<0.001. However, of the individuals originally qualifying for Type-D, N=72, only 41 or 56.9% still qualified for Type-D. Of those originally Non-D, N=213, 193 or 90.6% remained Non-D.

Is the total score of the DS14 used as a cut-off point, more temporally stable than the Type-D classification?

Figure 1 shows the temporal stability of using a sum score of the DS14 as the cutoff point for being D-like above that sum and Non-D-like if you score below that sum. All χ^2 values for the association of classification of D-like individuals at T1 vs. T2 were highly significant. The sum scores for the complete DS14 in this sample ran from a low of 2 to a maximum of 50 out of a potential range of 0-56. The values considered in the subsequent analysis as potential criteria run from 15 to 30. About a third or 35% of the sample scored less than 15; 90% scored less than 30.

188 Figure 1. Six-year temporal stability of D-like criterion vs. Type-D



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190 Note: on the x-axis the total score or sum of the DS14 response used as the cutoff point. On the y-axis the
191 percentage of T1 D-like individuals who were still D-like at T2. For easy reference, parallel to the x-axis, the
192 stability of Type-D membership, 56.9%.

193 It can be seen in Figure 1, that for temporal stability, the sum cut-off produces a higher
194 level of stability than Type-D personality criterion at all values from 15 to 30. Inevitably, the
195 prevalence of D-likeness goes down, as the cutoff point is raised: It is nearly half or 48.6% for
196 the sum of 15, and goes down in a near-linear fashion as one increases the value of the cutoff
197 point, to 9.5% for the value of 30. The highest temporal stability is for using 18 for the cutoff
198 point (80%) but the prevalence for D-like individuals with a sum of 18 is 37.9%, making it a
199 very common category. The prevalence most similar to Type-D prevalence is observed for the
200 cutoff point of 23 (23.8%). For the value of 23, 67.8% of T1 D-like individuals remain D-like at
201 T2, and the association for D-like membership is χ^2=121.966, p<0.001. However, as the graph

202 shows, a cutoff value of 23 is just higher than the minimum stability of the sum threshold (which
203 occurs at cut-off point 24).

204 *Is the product of the two sub-scale scores more stable than the Type-D criterion?*

205 The Type-D criterion is essentially non-linear. A non-linear alternative is to consider the
206 product of the two sub-scale scores. This was done by calculating the product of the two sub-
207 scale scores for each participant at each time point, and then setting a threshold for
208 multiplicative-D-ness at a value and checking what proportion of multiplicative-D-like
209 individuals retained their status at the six-year retest. Figure 2 below shows the results. The
210 product was 0 for individuals who scored 0 on one of the subscales. It should be noted that by the
211 standard Type-D criterion these individuals of course would not qualify for Type-D. The
212 maximum possible value for the product is 28^2=784; this maximal score was not found at either
213 time-point for any individual. At T1 there were 4 individuals with a score over 500 and at T2 3
214 such individuals. The product values considered in the subsequent analyses are 120 to 150;70%
215 of the participants had a product of less than 120, and 80% a product less than 150.

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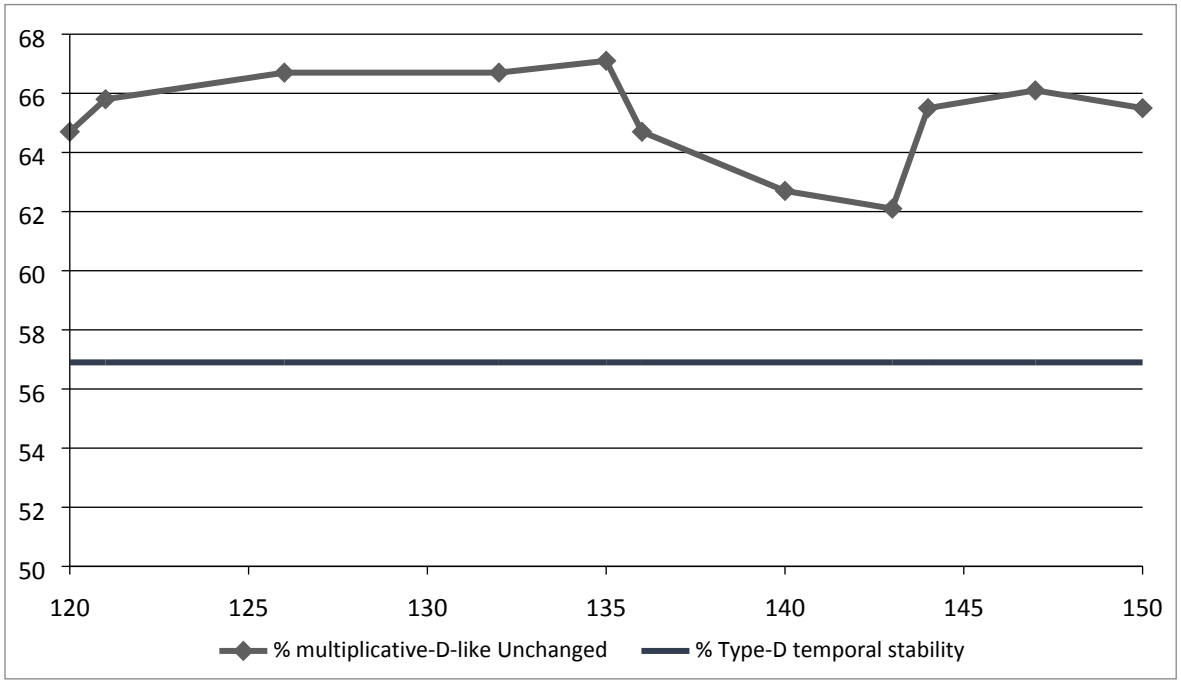
Figure 2. Six-year temporal stability of multiplicative-D-like criterion vs. Type-D.



Note: on the x-axis the product of the DS14 sub-scale scores used as the cutoff point. On the y-axis the percentage of T1 multiplicative-D-like individuals who were still multiplicative-D-like at T2. For easy reference, parallel to the x-axis, the stability of Type-D membership, 56.9%.

As Figure 2 shows, the temporal stability of the multiplicative-D-like criterion results in higher stability than Type-D membership for all values between 120 and 150. There is a local maximal stability point at product=135. Using 135 as the threshold, produces a prevalence of 23.6% and 24.9% at T1 and T2 respectively. This multiplicative criterion overlaps Type-D membership 81.7% and 85.9% at T1 and T2 respectively. Temporal stability of the product at-risk group for threshold 135 is 67.1%.

Can T2 Type-D membership at T2 be predicted using T1 personality variables?

T2 Type-D membership was entered as the dependent variable into logistic regression; independent variables used as predictors were the following T1 variables: the scores on both sub-

231 scales of the DS14 at T1, the seven TCI traits at T1, and the total alexithymia score on the
232 TAS20 at T1. The results of the logistic regression are shown in Table 1 below.

233

234 *Table 1. Summary of Binary Logistic Regression Analysis for T1 Personality Variables Predicting Type-*
235 *D Membership at T2 (n = 285), Controlling for Gender and Age*

Predictor	B	*SE B*	e^B
SI_{T1}	.207***	.06	1.23
NA_{T1}	.155**	.05	1.17
NS_{T1}	.017	.03	1.02
HA_{T1}	.011	.03	1.01
RD_{T1}	-.02	.03	0.98
PS_{T1}	-.02	.02	0.98
SD_{T1}	.001	.03	1.00
CO_{T1}	-.08*	.03	0.93
ST_{T1}	.04	.02	1.043
$TAS20_{T1}$	-.09*	.05	0.86
Constant	0.76		
χ^2(df=13)	100.23		

% predicted correctly T2 Type-D	49.2

Note: e^B = exponentiated *B* (Odds ratio). The T1 sub-script signifies that variables were measured at Time 1, 6 years prior to second testing of predicted Type-D. SI=social inhibition (DS14). NA=negative affect (DS14). NS=novelty seeking (TCI). HA=harm avoidance (TCI). RD=reward dependence (TCI). PS=persistence (TCI). SD=self-directedness (TCI). CO=cooperation (TCI). ST=self-transcendence (TCI). TAS20=total alexithymia score. *$p < .05$. **$p < .01$. ***$p < .001$.

As shown in Table 1, 49.2% of T2 type-D individuals were correctly predicted by the binary logistic regression equation. Since the ratio between Type-D and Non-D is 1:4By far the strongest predictors were DS14 subscale scores at T1, followed by some additional predictive power from the cooperativeness TCI character trait, which was inverse to Type-D classification, as was the T1 alexithymia score.

DISCUSSION

The current study found support for temporal stability of Type-D using a variety of approaches: it found temporal stability for the *prevalence* of Type-D caseness, and it found rank-order stability for the component traits negative affect and social inhibition, as high as that reported by Martens et al. (2007).

Also in support of the entity of Type-D, are the results of the binary logistic regression analysis. The best predictors of Type-D classification at Time2 were the Time1 DS14 trait scores. The original trait scores of social inhibition and negative affect, each measured by 7 items, did better than the seven TCI traits (each measured by 20 items) and better than the alexithymia scale (again 20 items). Since the prevalence of Type-D is less than1 in 4, the prediction provided by the logistic regression of nearly 1 in 2 was significantly above chance. Thus there is a particular affective and social style measured by the DS14 which is relatively

robust, and does better than other more elaborate personality scales in measuring these traits, as well as predicting the Type-D criterion, i.e. both sub-scale scores 10 or above, six years later.

A different but intuitively obvious measure of temporal stability is caseness: what proportion of those classified as Type-D at T1 will still be Type-D at T2, and what proportion of Non-D will remain Non-D? Is it enough that the Chi-Square value for the association is significant, or do we expect a higher level of temporal stability? The current study found, that six years later, only 56.9% of Type-D adult community volunteers remained Type-D, and 90.6% of those originally Non-D remained Non-D. Comparing this result to others in the extant literature is not trivial, because the research on the temporal stability of Type-D is relatively new, and in those studies published, the definition of temporal stability differs between studies.

For example, two studies of CVD patients, report the percentage of patients who remain Type-D at retest. In the Swedish study of CVD patients, over 12 months, 6.1% of individuals were Type-D at each of three consecutive testing times (Condén, Rosenblad, Ekselius, and Åslund, 2014). In a German study of CVD patients (Dannemann et al., 2010), 11.1% of individuals originally tested as Type-D remained Type-D 6 months later. This is not an intuitive measure of temporal stability, and obviously is not comparable to the proportion of Type-D and the proportion of Non-D who retain their status. Other studies report the proportion of temporal stability of Type-D classification overall, combining Type-D membership and Non-D membership (e.g. Pelle et al., 2008). Since Type-D individuals are about 1 in 4 or 1 in 5, the a-priori probability of remaining Type-D is much lower than the a-priori probability of remaining Non-D, thus overall temporal stability is not an informative measure for the stability of the at-risk-group Type-D.

In one of the studies it was possible to retrieve the relevant numbers for the temporal stability of Type-D classification as defined here. Dannemann et al. (2010) found that 14 of the 33 pre-surgery Type-D CVD patients, or 42.4%, remained Type-D post- surgery, and 77 of the 93 Non-D CVD patients, or 82.8% remained Non-D post- surgery.

Compared to this clinical sample, the current study showed high temporal stability, as it extends over a considerably longer time frame, and as more than half of the individuals originally identified as Type-D remained Type-D. However, the temporal stability of Type-D classification was significantly lower than that achieved for using the sum of the subscale scores or their product as a cutoff point. In particular, the product of the subscale scores had several advantages as a criterion: it showed a highly significant overlap with the classical Type-D classification, as well as having higher temporal stability.

Coyne and de Voogd (2012) claimed that Type-D classification has not been borne out by empirical research even though the component traits are of obvious importance, and suggest using alternative approaches to scoring the Type-Dness, based on the quasi-continuous subscale scores, rather than using the Denollet (2005) rule of 10 or more on both sub-scales. Subsequently, (Denollet, Pedersen, Vrints & Conraad, 2013), conducted a five-year longitudinal study of a series of over 500 CVD patients showed that Type-D did better at predicting major cardiac events than did its component traits, making the OR for any major cardiac event 1.74, and for cardiac death 2.35. This impressive study showed very strong "positive" results for Type-D's predictive validity, but did not address the question of the temporal stability. Was it the Type-D status at the beginning of the study that had this major effect? Was the effect different for those who remained stably Type-D throughout the five years of the follow-up? If Type-D status is less than 50% temporally stable in CVD patients, as seen in the Dannemann et al.

(2010) study, at what point does being Type-D exert its influence? Should being Type-D be construed of as a state of heightened risk, or as a trait of individuals at elevated risk?

The current study contributes to existing research on the temporal stability of Type-D by examining a community sample and not a CVD patient sample, by using a battery of well validated personality measures, and by having a relatively long inter-test interval. It suggests an alternative criterion for defining Type-D, based on the product of the DS14 subscales, which provides better temporal stability in a non-patient sample. However, the results of the study should be viewed with the study limitations in mind, i.e. they may not generalize well to CVD patients, especially those before and after a traumatic cardiac event or a major intervention. These life-threatening experiences may have a dynamic of their own. Further research is needed to clarify this point. However, since Type-D is designed to predict risk, its temporal stability is of prime importance, and the question of when it should be measured, or which of subsequent measurements is crucial to understanding the behavior and medical risk of CVD patients, requires further research.

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