**The role of Perceived Control, Social Support, and Socioeconomic Position on the relationship between Stress and Attitudes towards a VUCA-world in times of COVID-19.**

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**Abstract**

**Background:** The world becomes increasingly volatile, uncertain, complex, and

ambiguous (VUCA) (Johansen, 2007). The COVID-19 pandemic likely exacerbates the

experience of a VUCA-world, because the pandemic led to increased levels of uncertainty. Simultaneously, a VUCA-world can be perceived differently by people, more as a threat, but also as a challenge. This study investigated potential important factors (i.e., perceived control, social support and socioeconomic position) that influence dealing with stress, i.e., the threat vs. challenge experience, in the context of attitudes towards a VUCA-world.

**Methods:** A total of 54,703 persons were randomly selected from the region of

Utrecht and invited to fill in either a web-based or a paper questionnaire of the Public Health Monitor executed by the GGD and the municipality of Utrecht in collaboration with RIVM and CBS. 44,996 participants from 18 to 103 years old (*M* = 55.30, *SD* = 19.38), fully completed the used variables of the questionnaire. Multiple regression analyses, including moderation and mediation, were used.

**Results:** Findings showed that people with more stress have more negative

attitudes towards a VUCA-world, partly explained by perceived control. Experiencing more social support appears to be associated with less stress and more perceived control, which indirectly influences the attitude towards a VUCA-world. People with a lower socioeconomic position (SEP) experiencemore negative attitudes towards a VUCA-world, and less perceived control.

**Conclusions:** By, among the first, researching VUCA from a social science

perspective, it can be concluded that people differ in attitudes towards a VUCA-world. Results showed that stress, perceived control, and SEP shape whether the VUCA-world is perceived as a threat or a challenge. This research has lain the groundwork for a subsequent study in social science about a VUCA-world.

*Keywords: VUCA-world, attitudes towards a VUCA-world, stress, perceived control,*

*social support, socioeconomic position, challenge, threat.*

**Stress and Attitudes towards a VUCA-world in times of COVID-19**

Societal developments (e.g., the rise of the internet and globalization) follow each

other in rapid succession, which makes the world increasingly VUCA (Bal et al., 2018; Johansen, 2007). VUCA means ‘’a dynamically changing social context (volatile), missing clear information (uncertain), multiple potentially relevant dimensions (complex), and multiple possible interpretations of available information (ambiguous)’’ (Bodenhausen & Peery, 2009, p. 2).

The recent extreme world event, the COVID-19 pandemic, likely exacerbates the

experience of a VUCA-world. Due to the COVID-19 pandemic and the measures to prevent the spread of the virus, there have been new dramatic changes in life, which have proven to lead to increased levels of uncertainty (e.g., about whether everything will return to normal, the possible health consequences of an infection and consequences for income, social life, and mental health) (OECD, 2020; Thompson & Spacapan, 1991; Klerk et al., 2021). Still, people live their lives and make decisions, which due to uncertain consequences pose a form of risk (Fischhoff, 2020). For example, the decision to go to the supermarket or visit family with the danger to become infected and the decision to vaccinate when there is not much information.

Importantly, despite the possible view that VUCA could create a negative experience,

this is not necessarily the case. For example, research of RIVM (2021) shows that some people experience more flexibility which led to a positive experience of the pandemic. This indicates that the experience of a VUCA-world can differ for people. The biopsychosocial model of challenge and threat (BPS) suggests that a stressor, due to an evaluation of resources and demands, can be experienced as a challenge or threat (Seery, 2013). This study will investigate potential important factors (i.e., perceived control, social support and SEP) that influence dealing with stress (i.e., the threat vs. challenge experience) in the attitudes towards a VUCA-world.

**The relationship between Stress and Attitudes Towards a VUCA-world.**

Research about VUCA (i.e. volatile, uncertain, complex, and ambiguous) has foremost

been applied to business settings, with the purpose to develop the right leadership skills to deal with a VUCA environment (Lawrence, 2013). As argued by Johansen (2007), VUCA-prime (i.e. vision, understanding, clarity, and agility), the opposite of the VUCA model, describes which characteristics good VUCA leaders should have. Besides a study by Bodenhausen & Peery (2009) about how the aspects of VUCA shape processes of social categorization, the concept of VUCA has not yet been used extensively in social science and public health. My research focuses on people’s attitudes towards a VUCA-world, studying how important personal characteristics might be related, like making it easier or more difficult, to experience the current VUCA-world as a threat or challenge (e.g. as VUCA-prime). As such, I assume that everyone acknowledges that the world is VUCA, especially during the COVID-19 pandemic.

The biopsychosocial model of challenge and threat (BPS) provides a theoretical

understanding of individuals’ psychological responses, challenge or threat, to stressful events (Blascovich, 2008). In line with the BPS, a more positive attitude towards a VUCA-world stands for finding a VUCA-world pleasant, seeing it rather as a challenge. According to Rutter (2007), challenge could be conceptualized in terms of resilience, which means coping ‘well’ with a stressor. Secondly, a more negative attitude towards VUCA stands for finding VUCA unpleasant, seeing it rather as a threat. It reflects vulnerability, the lack of coping ‘well’ with a stressor, and finding it harder to navigate (Forbes-Mewett & Nguyen-Trung, 2019; Rutter, 2007).

The expectation is that people who already experience a higher stress level might be

more inclined to perceive VUCA as a threat. Stress can be defined as ‘’any type of change that causes physical, emotional, or psychological strain’’ (WHO, 2022, p. 1). Stress can change someone’s worldview. According to Braund et al., (2019) higher stress predicts a greater negativity bias. When people are more stressed, they tend to be more intolerant of uncertainty, meaning that they give more importance to negative experiences, which in turn, can lead to more mental problems (Braund et al., 2019; Buhr & Dugas, 2009). Besides, stressed and anxious people find estimating, adapting, and reacting to uncertainty more difficult and experience uncertainty as more negative (Browning et al., 2015; Gagne et al., 2020; Pulcu & Browning, 2019). Therefore, stress could lead to more negative attitudes toward a VUCA-world. Most research is about uncertainty, it is interesting to investigate whether this also applies to the entire VUCA concept.

**The Role of Perceived Control**

Stress could directly shape the experience of a VUCA-world. However, the estimation

of individual consequences due to a stressor and the feeling of having control could determine whether attitudes towards a VUCA-world are rather positive or negative. In line with that, the BPS suggests that individuals perform evaluations of resources and demands to experience a stressor as more negative or positive (Seery, 2013). Therefore, perceived control, ‘’the belief in one’s ability to exert control over situations or events’’ (Ly et al., 2019, p. 1), could serve as a mediator.

In general, studies found that people with more stress experience less perceived

control (Averill, 1973; Weinstein & Ryan, 2011). They have trouble continuing functioning and clear thinking, and they have a feeling of being unable to cope (Weinstein & Ryan, 2011). According to Jones et al., (2009), people with less perceived control may have less ability to cope with stressors which results in a more negative state (Jones et al., 2009; Nelson & Shankman, 2011). In addition, according to Bredemeier & Berenbaum (2008), a high intolerance of uncertainty leads to lower perceived control, which in turn leads to a more threat state. It is interesting to find out whether perceived control also mediates the relationship between stress and attitudes towards a VUCA-world.

**The Role of Social Support**

In addition to the more psychological aspect, perceived control, the social aspect is

important as well. Namely, Forbes-Mewett and Nguyen-Trung (2019) argued that social support is an important resource that prevents one from the effects of stressors. ‘’Social support is a broad construct that describes the network of social resources (i.e. emotional, cognitive, material) that an individual perceives (Zhou, 2014, p.1).’’

Social support may moderate the relationship between stress and attitudes towards a

VUCA-world. Specifically, this effect would be weaker for people with more social support because it buffers persons from the potentially negative influence of stressful events. A social network can help to reduce stress (Kirschbaum et al., 1995). According to Cohen and Wills (1985, p. 1): ‘’Social support prevents individuals from negatively reacting to stress by redefining it as not stressful, increasing an individual's ability to proactively and reactively cope with the stressor and providing solutions for stress.’’ The same moderating role of social support in the relationship between stressors and negative effects of stressors has been supported by at least two studies (Dahlem, et al., 1991; Monroe, et al., 2014).

**The Role of Socioeconomic position**

From a sociological perspective, groups of people deal with stressors differently

(Ouwehand et al., 2009). Socioeconomic position (SEP)[[1]](#footnote-1) may be associated with the factors that shape whether the VUCA-world is perceived as a threat or challenge.

First, SEP may predict stress and attitudes towards a VUCA-world negatively. Lower

SEP is generally associated with more stress (Baum, et al., 2006; WHO, 2022). According to Scott (2014), this can be explained by more exposure to stressful life experiences which have a more negative impact (Scott, 2014). To illustrate, during the COVID-19 pandemic, people with a lower SEP were infected more often because they were not able to protect themselves properly. This resulted, due to their worse health situation, in a higher risk of negative health outcomes (Khalatbari et al., 2020). In addition, higher resources, in general, could lead to a more positive experience of a stressor, according to the BPS model (Seery, 2013). Overall, this leads to the expectation that a higher SEP is associated with less stress and less negative attitudes towards a VUCA-world.

Second, SEP may predict perceived control positively. Bailis et al., (2001) and

research by CBS et al. (2016) argue that people with higher SEP experience more control over their lives than people with a lower SEP. People with a higher SEP have more ability to put things into perspective, redefine and cope with a stressor (Cohen & Wills, 1985). Overall, this would indicate that higher SEP is associated with higher perceived control.

Third, SEP may predict social support positively. People with a higher SEP generally

have a wider and more diverse social network (Algren et al., 2020; Kraaykamp, et al., 2018). They have more material resources, resulting in more possibilities to meet new people and provide and therefore receive support (Weyers, et al., 2008). In addition, people with a higher SEP have more cognitive resources and skills (e.g. learning and collecting information) which help to develop and maintain social relationships ([Broese van Groenou & van Tilburg, 2003](javascript:;)). Overall, this would indicate that higher SEP is associated with a higher level of social support.

## The Current Study

This research focuses on the relationship between stress and attitudes towards a VUCA-world. By adding the ‘characteristics’: perceived control, social support, and SEP, the study contributes to the knowledge gap of applying VUCA from a social science perspective. It is important to get more knowledge about the impact of a due to COVID-19 enhanced VUCA-world and which groups need support. To properly support these groups, it is important to understand which personal characteristics make it easier to experience the current VUCA-world as a threat. As such, the outcomes of this research could be used to develop new and better-targeted policies for different people.

The combination of the theoretical approaches from different disciplines more specific insights into stress and attitudes towards a VUCA-world (individual) and the mechanisms and factors (personal and structural factors and interpersonal processes) that facilitate resilient functioning in an increasingly VUCA-world, wherefore we need an interdisciplinary perspective according to Topel (2022).

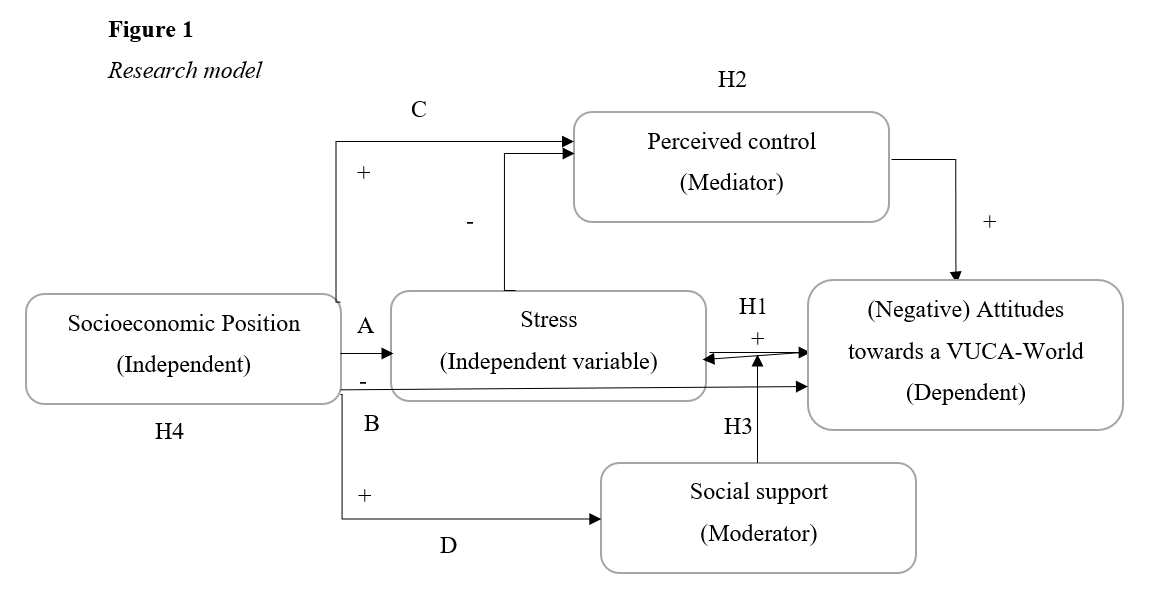
Taken together, this research examines the question: ‘To what extent do perceived control, social support, and SEP influence the relation between stress and attitudes towards a VUCA-world in times of the COVID-19 pandemic?’ Based on the existing research, the following hypotheses are formulated (see Figure 1).

*H1:* There is a positive relationship between stress and attitudes towards a VUCA-world.

*H2:* The relationship between stress and attitudes towards a VUCA-world is mediated by perceived control.

*H3:* The relationship between stress and attitudes towards a VUCA-world is moderated by social support.

*H4:* There is a negative relationship between SEP and stress *(H4a)*, attitudes towards a VUCA-world *(H4b),* perceived control *(H4c),* and social support *(H4d).*

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**Method**

**Design and procedures**

Secondary data has been used from the Public Health Monitor executed by the GGD

and the municipality of Utrecht in collaboration with RIVM and CBS, in the Netherlands. The main goal of the Public Health Monitor is to support local and national policies, by gaining insight into the health of citizens. The survey seeks to measure concepts involved in health. The questions about VUCA were requested by researchers from the University of Utrecht. The GGD and the municipality of Utrecht did two separate studies that have been merged.

In the autumn of 2020, on behalf of the GGD, CBS has drawn a sample of residents

aged 18 and older, living independently from all municipalities in the region and where possible at the district level. The participants were approached in September 2020, by post with paper questionnaires and a QR code to an online questionnaire. After that, a reminder letter was sent twice. In December 2020, the data collection was closed. The response rate on average was 43%. By weighting the response by the CBS, there is a decrease in deviation between the sample and the actual population.

The Public Health Monitor takes place every 4 years. Nevertheless, for this

study, only the wave of December 2020 has been used, due to the one-off VUCA request. Before participation, people were informed about the study and procedures for ending participation, at any moment. Active informed consent was used. The survey was anonymous. It took about 30 minutes to complete the survey. The research has been assessed by the FETC (Facultaire EthischeToetsingscommissie) and approved (file number: 22-0572).

**Participants and sampling**

The total original sample of the studies involved a total of 54,703 inhabitants of

the province of Utrecht. However, there were participants with missing values for items of VUCA (*n =* 4134), stress (*n =* 2840), perceived control (*n =* 4518), social support (*n =* 5719) and SEP (*n =* 2814). Many people with missing values on one variable also had missing values on another. In total, people with missings (*n =* 9707) on the used variables have been excluded from the analyses[[2]](#footnote-2)

The final sample of this study consisted of 44,996 participants. The participants were

18 till 103 years old (*M* = 55.30, *SD* = 19.38). 45.5% were higher educated, 29,3% middle, and 25,2% lower educated. Approximately half of the participants were women (51.9%). 12,8% were having a migration background.

**Measurements**

**Attitudes towards a VUCA-world.** The dependent variable is negative attitudes

towards a VUCA-world. In this survey, attitudes towards a VUCA-world was measured by a 4-item scale. First, volatile was measured by the item; ‘the world is changing fast’. Second, uncertainty, ‘life is sometimes unpredictable’. Third, complex, ‘the world becomes increasingly complicated’. Lastly, ambiguous, ‘in the world where we live are things often in different ways understandable’. These items were measured on a 7-point Likert scale ranging from (1) ‘very annoying’ to (7) ‘very pleasant’. These have been reversed. A mean scale has been made. Higher scores indicate a more negative attitude towards a VUCA-world. In this study, Cronbach’s *α* = .850.

**Stress**. The independent variable is stress. In this survey this was measured with the

item: ‘Did you experience stress in the past 4 weeks, by, for example, work/study, family, health, care, finance, or social media?’. Response categories ranged from (1) ‘no (almost) not’ to (4) ‘yes, very much stress’. A higher score on this item means more experienced stress.

**Perceived control.** The mediator is perceived control. In this survey, perceived

control was measured by a 7-item scale developed by Pearlin and Schooler (1978). The scale measures ‘being in charge of own life’, by for example; ‘What happens to me in the future mostly depends on me’. Response categories ranged from (1) ‘strongly agree’ to (7) ‘strongly disagree’. Two items have been reversed. Higher scores indicate a higher level of perceived control. In this study, Cronbach's *α* = .816.

**Social support.** The moderator is social support. Social support was measured with 11

items, based on the loneliness scale of Jong-Gierveld and Tilburg (1999). The scale consists for example of the item ‘There are plenty of people I can fall back on in case of trouble’. Response categories ranged from (1) ‘yes’ to (3) ‘no’. Dichotomous variables have been created, (0) ‘no to little social support’ and (1) ‘social support’. A sum score has been made. A higher score means more social support. In this study, Cronbach’s α = .873.

**Socioeconomic position (SEP).** Another independent variable is SEP. In this survey,

SEP was measured with education level; ‘What is your highest completed education?’. Response categories range from (1) ‘no completed education’ to (8) ‘science education completed’. This has been changed into 3 categories (1) ‘Low = Geen opleiding, lager onderwijs, lbo, mavo’ (2) ‘Middle = Mbo, havo, vwo’ (3) ‘High = Hbo, wo’. This item follows the Dutch educational system. A higher score means a higher SEP.

**Covariates**: Gender, age, and ethnicity were included as covariates because

earlier research showed that these factors could influence coping with stress (Ptacek et al., 1994). See appendix C for the questionnaire of all used variables.

**Analyses**

Separate analyses were conducted using IBM SPSS Statistics 26. First, to test hypothesis H1, a multiple regression analysis has been conducted. To test the mediating role of perceived control (H2) PROCESS macro, recommended by Hayes (2013), has been used. To test the moderating role of social support (H3) interaction effects has been included in the regression analysis and the variables have been centered. Also, for hypothesis H4a, H4b, H4c and H4d four separate regression analyses have been applied. Before testing, the assumptions of multiple regression analyses were checked, and no big violations were found, see appendix A.

Because of the large sample size, many significant effects have been found. Therefore, the cut-offs for R-squared *(R2)*, 0.02 (small), 0.13 (medium) and 0.26 (large) have been used (Cohen, 1992). Significant results with an effect size lower than .02, are not meaningful and therefore will not be reported. When the effects are meaningful, the beta (*β* ) will be reported, except from the mediation analysis, to look specifically at the effects of the variables. The cut-offs for beta *(β*); ~0.3 (small), ~0.5 (medium), and >0.6 (large) have been used (Cohen, 1998)

**Results**

As indicated in Table 1, attitudes towards a VUCA-world score relatively

high (*M* = 4.51, *SD* =.99), meaning that people, in general, have rather negative attitudes towards a VUCA-world. People with a lower education level were more likely to have negative attitudes towards a VUCA-world than people with a higher education level (F(2,44996) = 2701.11, p <.001). On average, people experience high levels of perceived control (*M* = 3.86, *SD* =.71) and social support (*M* = 8.08, *SD* =.31) . People with a lower education level reported less perceived control (*M =* 3.64, *SD* = .77) and less social support (*M* = 7.68, *SD* = 3.24), than people with a higher education level.

Afbeelding met tafel

Automatisch gegenereerde beschrijving

Regarding stress, 62.1% of the people in the region of Utrecht have experienced

stress in the past four weeks. Due to the pandemic, 22.2% of the people experience more stress, and 5.6% experience less control[[3]](#footnote-3). There was a significant, low positive correlation between change in stress and attitudes towards a VUCA-world (*r*(44996)= .05; *p* < .001). This means that people with more stress due to the COVID-19 pandemic have more negative attitudes towards a VUCA-world. Change in control due to the pandemic is not correlated with negative attitudes towards a VUCA-world.

In Table 2, bivariate correlations between the studied variables are shown. All

variables are correlated with attitudes towards a VUCA-world and stress. Social support and perceived control are correlated strongly (*r* = .42). As gender, age and ethnicity significantly correlated with attitudes towards a VUCA-world, they were included as covariates in the regression analyses.

Afbeelding met tafel

Automatisch gegenereerde beschrijving

**The relationship between stress and attitudes towards a VUCA-world**

The results of the linear regression analyses showed support for the hypothesis 1 (H1),

stress is positively associated with attitudes towards a VUCA-world *(F*(4, 44995) = 966.92, *p* = <.001, *R2* = .08), see table 3 (Model 2). However, the beta (*β* = .16) shows a small effect of stress.

A regression analysis with all aspects was conducted as well. Model 3 shows that

perceived control (*β* = -.24) and SEP (*β* =-.24) are the largest predictors of attitudes towards a VUCA-world. The predictors all together explain 22% of the variance of attitudes towards a VUCA-world.

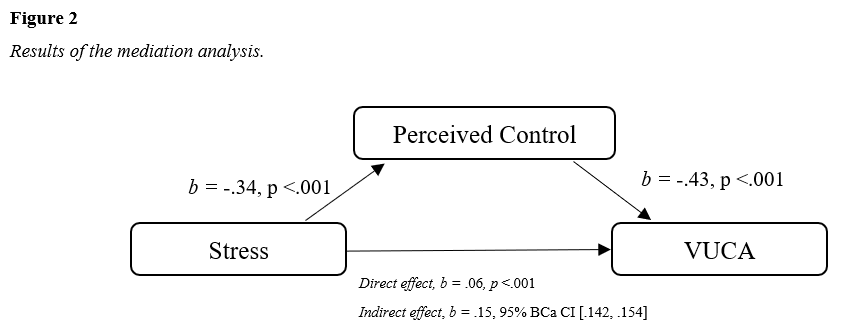
Afbeelding met tafel

Automatisch gegenereerde beschrijving

**The mediating role of Perceived control**

The results of the mediation analysis showed support for hypothesis 2 (H2).

Perceived control is a partial mediator of the relationship between stress and attitudes towards a VUCA-world, figure 2. Both, stress and perceived control, are associated with a negative attitude towards a VUCA-world (*t*(44996)= 8.92; *p* <.001), (*t*(44996)= -66.92; p <.001). There was a significant indirect effect of stress on attitudes towards a VUCA-world through perceived control, *b =* .15, 95% BCa CI [.142, .154]. The explained variance of the model is significant (*F*(5, 44990) = 1746.08; *p* <.001, *R²* = .16).



**The moderating role of Social Support**

The results of the moderation analysis showed no support for hypothesis 3 (H3).

A moderation effect has been found, however, it is too small to report, and will therefore be considered as not meaningful, see table 4.

Nevertheless, social support is expected to play a role, so additional analyses have

been performed, showing that people with more social support experience less stress and more perceived control, see appendix B for the results.

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**The role of SEP**

The results of the linear regression analyses showed partial support for the hypothesis

4 (H4). In table 5, Model 2 shows support for H4b, SEP is negatively associated with attitudes towards a VUCA-world (*F*(4, 44995) = 1685.88; *p* <.001, *R2* = .13). This means that people with a higher SEP experienced less difficulty navigating a VUCA-world. However, the beta (*β =* .28) shows a small effect. Model 3 shows support for H4c, SEP is negatively associated with perceived control (*F*(4, 44995) = 557.54; *p* <.001, *R2* = .05). This means that people with a higher SEP experience more perceived control. However, the beta (*β =* .17) shows a small effect. Lastly, model 4, shows that the relationships between SEP and stress and SEP and social support are too small to rapport (H4a, H4d).

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**Discussion**

The results show that people with stress experience more difficulty navigating a

VUCA-world. This is in line with previous research, suggesting that higher stress predicts a greater negativity bias (Braund et al., 2019) and that stressed people struggle more with estimating, adapting, and responding to uncertainty (Browning et al., 2015; Gagne et al., 2020; Pulcu & Browning, 2019). Nevertheless, the effect size is small, which may be because of the differences in areas in which stress is experienced (e.g. work pressure versus housing market), which probably have different influences on attitudes towards a VUCA-world. Nevertheless, the results provide support for Hypothesis 1.

Secondly, results show that people with more stress experience less perceived

control and those people experience more difficulty navigating a VUCA-world. This mediating role of perceived control is consistent with previous research suggesting that people with stress can have a feeling of being unable to cope with stressors, and can have difficulties thinking clearly (Weinstein & Ryan, 2012). Also, research supports that perceived control plays a mediating role in the relation between intolerant of uncertainty and threat experience (Bredemeier & Berenbaum, 2008). The findings provide support for hypothesis 2.

Thirdly, results show that social support does not have the buffering role as

expected. A possible explanation is the measurement of social support in which only emotional support is included. The other types of social support (i.e. material and cognitive support) could offer someone more knowledge, advice, and resources (Scott, 2014). Concerning navigating in a VUCA-world, this kind of support could be used more as a buffer than the feeling of trust and belonging. Nevertheless, additional analyses found that people with more (emotional) social support experience more control and less stress, both of which indirectly contribute to attitudes towards a VUCA-world. As such, while not a direct moderator, it could be that emotional social support provides some sense of security and confidence that stressful circumstances can be handled (Scott, 2014). While this does not directly support hypothesis 3, it does support the idea that social support may play a role.

Fourthly, results show that people with a lower SEP experienced more negative

attitudes towards a VUCA-world, and lower perceived control. This is in line with previous research, which states that people with a higher SEP have more resources (e.g. information, and ability to cope), which is associated with experiences of a stressor, and perceived control (Cohen & Wills, 1985; Seery, 2013). However, SEP seems not to be an important factor for social support and stress. Regarding social support, this may be explained by the measurement of social support. Possibly, SEP can shape more material and cognitive support by resources, instead of shaping emotional support. Regarding stress, it can be explained by the finding that people with a higher SEP have more work stress and more performance pressure than people with a lower SEP (Damaske et al., 2016; [Moen et al. 2013](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4897969/#R23)). Since 'work stress' was mentioned as an example in the question, see appendix C, it is more likely that people with higher SEP also indicated experiencing stress. Nevertheless, it is interesting to investigate this more in further research, also considering different areas of stress. In the analyses of SEP, only small effects have been found. Possibly, if income and status were also included in SEP, larger effects would be found. Overall, it provides partial support for hypothesis 4.

The current study was among the first to investigate VUCA from a social science perspective, by studying how attitudes towards a VUCA-world are shaped by stress, perceived control, social support, and SEP. As such, it contributes to the current limited understanding of this research topic. The extensive model provides a lot of insight into how the factors (personal, structural, and interpersonal) are related to each other, possibly influencing each other and making it easier or more difficult to navigate in the current VUCA-world. The VUCA-world has been extremely magnified in times of COVID-19, which makes it important to delve into this now. Furthermore, the large sample size (*n* = 44,996) and its representativeness contribute to the external validity and reliability. Nevertheless, due to the large sample, many results are significant. This has been solved by looking to effect sizes.

Despite its contribution, some limitations have to be noted. First, the study design was cross-sectional and, therefore, a causal conclusion could not be drawn. Nevertheless, some ordering of effect could be expected based on theorizing. For instance, concerning the BPS, perceived control partly determined by SEP and social support, can be seen as a resource, which determines whether the current VUCA-world is experienced as a threat or challenge. Second, while this study largely rested on validated questionnaires, the VUCA items have not been validated yet as they are a new construct in social science. However, this study may lay the groundwork for a subsequent study, where validation is recommended. Besides, the concept of social support may not be fully measured here, in terms of material and cognitive support. However, it does indicate what the relationship might be like. Results concerning social support must be interpreted tentatively, future research can use a validated measure with all aspects of social support. Finally, the missings on VUCA, social support, and perceived control were not random. Specifically, the group with missings is generally lower educated, possibly explained by the relatively difficult questions. In future research, it is important to be aware of this. However, because of the large sample size of this study, still valid statements can be made. In addition, mean imputation was applied to social support due to the large scale (11 items), when people had less than three missings (*n =* 2518), to make the distribution fairer and keep as many respondents as possible.

All in all, this research showed that people with more stress experience more threats from a VUCA-world, which can be partly explained by perceived control. People with more stress generally experience less control and people who experience less control have more difficulty navigating in a VUCA-world. Experiencing more social support appears to be associated with less stress and more perceived control, which indirectly shape attitude towards a VUCA-world. People with a lower SEP experience more negative attitudes towards a VUCA-world, and less perceived control. SEP seems to be a less important factor in predicting social support and stress.

Based on the findings, several recommendations can be made. Firstly, it is important

to focus on increasing people’s perceived control. By increasing perceived control, it is important to improve the ability to make decisions, determined by knowledge, skills, and self-confidence (Movisie, 2016). ‘Het Wegwijscafé’ is a Dutch example in which volunteers and professionals support people to increase perceived control. Also, 'Krachtwerk' intervention of Movisie (2016) is seen as effective for groups of people who have temporarily lost control and are (at risk of becoming) socially excluded. Secondly, the focus on people with a lower SEP is important, especially on increasing ones perceived control. RVS (2020) argues that not only compensating for a lack of knowledge is important, but also having a broad view aimed at the resilience of society is necessary. Therefore, for increasing perceived control and paying attention to people with a lower SEP, local policy should focus on what is important for different groups specifically in the region, to make it easier for people to navigate in the current VUCA-world. An integral approach, due to the interrelatedness of many factors, with a focus on resilience, is important. Tentatively, these types of measures could be more effective than a focus on social support and stress. However, in the integral approach, the social aspect and stress, also by people with higher SEP, should not be forgotten.

In the future, longitudinal research is important to be able to make causal statements.

Further research may further investigate which other factors (e.g. anxiety) are shaping attitudes towards a VUCA-world. People with anxiety, same as stressed people, seem to experience uncertainty as more negative (Browning et al., 2015). In addition, it is important to research how individual consequences of the pandemic (e.g. lost a loved one or lost work during the pandemic) shape attitudes towards VUCA-world, to further investigate the link between COVID-19 and a VUCA-world. Qualitative research, with its deeper insights, can also play parts in understanding the concept properly. Lastly, although we have an idea of the possible consequences of negative attitudes towards a VUCA-world (e.g. experiencing more stress, less perceived control, and maybe even social exclusion), the actual consequences have to be investigated. This research has lain the groundwork for a subsequent study about a VUCA-world in social science and public health.

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**Appendix A: Assumptions**

All assumptions regarding multiple regression have been checked. Some outliners have been found, Std. residuals = max 3.905, Mahala Nobis distance max = 115.23. Z-scores have been made (> 3), which gives indications to outliers. However, according to the results of the comparison of these Mahala Nobis Distances to a chi-square distribution with the same degrees of freedom, no multivariate outliner was extreme. Nevertheless, no influential cases have been found, Cook’s distance and Leverage = < 1. Linearity, homoscedasticity of Residuals, and Normality have been checked by P-P Plots and Histograms. The dependent variable is practically normally distributed. However, because of the large sample, it does not matter because the sampling distribution will be normal, regardless of how the data looks (Field, 2018). Besides, as the bootstrapping method of PROCESS is a non-parametric test, the assumption of normality does not need to be met in the case of the mediation analyses. There was however no risk of multicollinearity because the VIF values were lower than 10 and the tolerance above 0.2, which are the general guidelines according to Field (2018).Overall, no big violation have been found, therefore the analyses have been conducted.

**Appendix B: Additional Research**

Social support does not appear to be a moderator between stress and attitudes towards a

VUCA-world. Therefore, two separate additional analyses have been conducted, see table

First, as expected, social support is negatively associated with stress (*b =* -.07, *F*(4, 44995) = 3297.72, p <.001, *R2* = .23), model 1.

Second, social support is positively associated with perceived control (*b =* .10, *F*(4, 44995) = 2651.63, p <.001), *R2* =.19), model 2.

Afbeelding met tafel

Automatisch gegenereerde beschrijving

**Appendix C**

**Items of the Public Health Monitor (in Dutch)**

**Attitudes towards a VUCA-world**

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**Stress**

**Afbeelding met tekst

Automatisch gegenereerde beschrijving**

**Perceived control**

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**Social support**

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**SEP**

**Afbeelding met tekst

Automatisch gegenereerde beschrijving**

**Gender**

**Afbeelding met tekst

Automatisch gegenereerde beschrijving**

**Age**

****

**Emotional change due to covid**

**Afbeelding met tafel

Automatisch gegenereerde beschrijving**

**Appendix D**

**Syntax**

\* Encoding: UTF-8.

\* Encoding: .

\*Samengevoegd databestand openen (zie andere syntax)

GET

FILE=' FILE='W:\GGGD\G&E\2 Epidemiologie & Informatie\2. Verdiepend onderzoek monitoring\stages\Stage '+

'Sybrit\Analysebestand\Orginele bestanden/ GP20 GGDru en VG Utrecht - kopie.sav'.

DATASET NAME DataSet2 WINDOW=FRONT.

\*Save work file under new name (titled: 'Final').

SAVE OUTFILE= FILE='W:\GGGD\G&E\2 Epidemiologie & Informatie\2. Verdiepend onderzoek monitoring\stages\Stage '+

'Sybrit\Analysebestand\Finalsav'.

/COMPRESSED.

\*DATASCREENING.

\* Inspect variables in variable view.

\*DATACLEANING.

\*Attitudes towards a VUCA-world ('VUCA').

\*VUCA ompolen, want hogere score = meer negatieve attitude towards vuca.

RECODE VUCAL201 VUCAL202 VUCAL203 VUCAL204 (7=1) (6=2) (5=3) (4=4) (3=5) (2=6) (1=7) INTO VUCA1

VUCA2 VUCA3 VUCA4.

EXECUTE.

\*VUCA cronbach's alpha checken. Cronbach's alpha = .850.

RELIABILITY

/VARIABLES=VUCAL201 VUCAL202 VUCAL203 VUCAL204

/SCALE('ALL VARIABLES') ALL

/MODEL=ALPHA.

\*VUCA vragen naar op minimaal 1 missing = 4134 + alle eruit.

\*VUCA variabele maken, met alleen de gemiddelden van alle 4 ingevuld.

COMPUTE VUCA=MEAN.4(VUCA1,VUCA2,VUCA3,VUCA4).

EXECUTE.

\*Define variable label VUCA.

VARIABLE LABELS VUCA 'Attitudes towards a VUCA-world'.

\*Add value label VUCA.

ADD VALUE LABELS

1 'Very positive attitude towards a VUCA-world'

2

3

4

5

6

7 'Very negative attitude towards a VUCA-world'.

\*Define variable level VUCA.

VARIABLE LEVEL VUCA (SCALE).

\*Define missing values VUCA.

MISSING VALUES VUCA (999).

\*Remove unnecessary decimals.

FORMATS VUCA (F8.0).

EXECUTE.

\*Stress.

RENAME VARIABLES (GGSTB201 = Stress).

\*Perceived control.

\*Observing perceived control.

FREQUENCIES VARIABLES=GGRLB201 GGRLB202 GGRLB203 GGRLB204 GGRLB205 GGRLB206 GGRLB207

/ORDER=ANALYSIS.

\*ompolen GGRLB206 GGRLB207.

RECODE GGRLB206 GGRLB207 (1=5) (2=4) (3=3) (4=2) (5=1) (9=9).

EXECUTE.

\*Cronbach's alpha van perceived control.

RELIABILITY

/VARIABLES=GGRLB201 GGRLB202 GGRLB203 GGRLB204 GGRLB205 GGRLB206 GGRLB207

/SCALE('ALL VARIABLES') ALL

/MODEL=ALPHA

/SUMMARY=TOTAL.

\*Perceived Control, hou ik het op mean.7 want niet heel veel missings minder en beetje lagere gemiddelde.

COMPUTE Control =MEAN.7(GGRLB201,GGRLB202,GGRLB203,GGRLB204,GGRLB205,GGRLB206, GGRLB207).

EXECUTE.

\*Define variable label perceived control.

VARIABLE LABELS Control 'Perceived control'.

\*Add value label Control.

ADD VALUE LABELS

1 'Very less perceived control'

2

3

4

5 'Very much perceived control'.

\*Define variable level Control.

VARIABLE LEVEL Control (SCALE).

\*Define missing values VUCA.

MISSING VALUES Control (999).

\*Remove unnecessary decimals.

FORMATS Control (F8.0).

EXECUTE.

\*Social Support

\*sociale steun bekijken.

DESCRIPTIVES VARIABLES=GGEEB201 GGEEB202 GGEEB203 GGEEB204 GGEEB205 GGEEB206 GGEEB207 GGEEB208

GGEEB209 GGEEB210 GGEEB211

/STATISTICS=MEAN STDDEV MIN MAX.

\*ompolen zodat hogere score meer sociale steun is.

RECODE GGEEB201 GGEEB204 GGEEB207 GGEEB208 GGEEB211 (3=1) (2=2) (1=3) (9=9).

EXECUTE.

\*Cronbach's alpha sociale steun. .873.

RELIABILITY

/VARIABLES=GGEEB201 GGEEB202 GGEEB203 GGEEB204 GGEEB205 GGEEB206 GGEEB207 GGEEB208 GGEEB209

GGEEB210 GGEEB211

/SCALE('ALL VARIABLES') ALL

/MODEL=ALPHA

/SUMMARY=TOTAL.

\*Factoranalyse sociale steun.

FACTOR

/VARIABLES GGEEB201 GGEEB202 GGEEB203 GGEEB204 GGEEB205 GGEEB206 GGEEB207 GGEEB208 GGEEB209

GGEEB210 GGEEB211

/MISSING LISTWISE

/ANALYSIS GGEEB201 GGEEB202 GGEEB203 GGEEB204 GGEEB205 GGEEB206 GGEEB207 GGEEB208 GGEEB209

GGEEB210 GGEEB211

/PRINT INITIAL EXTRACTION

/CRITERIA MINEIGEN(1) ITERATE(25)

/EXTRACTION PC

/ROTATION NOROTATE

/METHOD=CORRELATION.

\* De antwoorden op alle items worden gedichotomiseerd in 'geen tot weinig sociale steun' versus 'sociale steun'' (de middelste antwoordcategorie wordt dus tot geen tot weinig (net als bij eenzaamheidsschaal) gerekend) .

RECODE GGEEB201 GGEEB202 GGEEB203 GGEEB204 GGEEB205 GGEEB206 GGEEB207 GGEEB208 GGEEB209 GGEEB210 GGEEB211 (1=0) (2=0) (3=1) INTO GGEEB201d GGEEB202d GGEEB203d GGEEB204d GGEEB205d GGEEB206d

GGEEB207d GGEEB208d GGEEB209d GGEEB210d GGEEB211d.

EXECUTE.

\*Maken schaal. \*Sociale steun vragen naar 0 missings, 1 of 2, uitkomst is doorgaan met mean.9, want gemiddelde blijft ongeveer gelijk, maar wel ongeveer 2000 meer respondenten die dan meegenomen kunnen worden

Bij VUCA is het anders, maar hier is het niet erg als ze 2 niet hebben ingevuld.

COMPUTE Support = Sum.9(GGEEB201d, GGEEB202d, GGEEB203d, GGEEB204d, GGEEB205d, GGEEB206d,

GGEEB207d, GGEEB208d, GGEEB209d, GGEEB210d, GGEEB211d).

EXECUTE.

\*Define variable label Support.

VARIABLE LABELS Support 'Social Support, total score'.

\*Add value label Support.

ADD VALUE LABELS

1 'No social support'

2

3

4

5

6

7

8

9

10

11 'Very much social support'.

\*Define variable level Support..

VARIABLE LEVEL Support (SCALE).

\*Define missing values Support.

MISSING VALUES Support (999).

\*Remove unnecessary decimals.

FORMATS Support (F8.0).

EXECUTE.

\*Sociaoeconomic position ('SEP').

\*Create new variabele for SEP by education level but with 3 categories.

RECODE opleiding\_vmu(1 THRU 2= 1)(3=2)(4=3)(else=copy) INTO SEP.

\*Define variable label SEP.

VARIABLE LABELS SEP 'Educational level coded in 3 categories'.

\*Add value labels SEP.

ADD VALUE LABELS SEP

1 'Geen opleiding, lager onderwijs, lbo, mavo'

2 'mbo, havo, vwo'

3 'hbo, wo'

99 niet ingevuld.

\*Define variable level SEP.

VARIABLE LEVEL SEP (NOMINAL).

\*Define missing values SEP.

MISSING VALUES SEP(999).

\*Remove unnecessary decimals.

FORMATS SEP (F8.0).

EXECUTE.

\*Controleren of het klopt. Het klopt.

CROSSTABS opleiding\_vmu BY SEP.

\*AGE.

RENAME VARIABLES (LFT0109 = Age).

\*Gender.

RENAME VARIABLES (Geslacht = Gender).

RECODE GENDER (1=1) (2=0).

ADD VALUE LABELS Gender

0 'Female'

1 'Male'.

\*Ethnicity.

RENAME VARIABLES (etnicvmu = Ethni).

-----------------------------------------------------------------------------------------------

\*Missings.

\*Run refequencies and descriptives of all variables to get a indication of missings.

\*Conclusion: missings on VUCA, Stress, SEP, Support and Control.

FREQUENCIES VARIABLES= Ethni Gender SEP

/STATISTICS=STDDEV MEAN

/ORDER=ANALYSIS.

DESCRIPTIVES VARIABLES= VUCA STRESS CONTROL SUPPORT AGE

/STATISTICS=MEAN STDDEV MIN MAX.

\*Missings bekijken per variabele.

\*Missings variabele bekijken VUCA.

RECODE VUCA (MISSING=0) (1 thru 7=1) INTO VUCAmissing.

EXECUTE.

\*Missing variabele bekijken Stress.

RECODE Stress (MISSING=0) (1 thru 4=1) INTO Stressmissing.

EXECUTE.

\*Missing variabele bekijken Opleidingsniveau.

RECODE SEP (MISSING = 0) (1 thru 3=1) INTO SEPmissing.

EXECUTE.

\*Missing variabele bekijken sociale steun.

RECODE Support (MISSING = 0) (1 thru 11=1) INTO Supportmissing.

EXECUTE.

\*Missing variabele bekijken eigen regie.

RECODE Control (MISSING = 0) (1 thru 5=1) INTO ControlMissing.

EXECUTE.

\*Frequencies van missings.

FREQUENCIES VARIABLES= VUCAmissing SEPmissing Supportmissing ControlMissing StressMissing

/STATISTICS=STDDEV MEAN

/ORDER=ANALYSIS.

\*Kijken of er een significant verschil zit tussen de gemiddelde leeftijd van mensen die het wel hebben ingevuld en gemiddelde leeftijd niet ingevuld (missings)

Formulier gemaakt in word over deze resultaten. Conclusie is mensen met missings lager opgeleid zijn, maar doordat er zoveel respondenten zijn valt het mee. Nu kijken per item hoeveel alle items niet hebben ingevuld.

T-TEST GROUPS=VUCAmissing(0 1)

/MISSING=ANALYSIS

/VARIABLES= AGE

/CRITERIA=CI(.95).

T-TEST GROUPS=Stressmissing(0 1)

/MISSING=ANALYSIS

/VARIABLES= AGE

/CRITERIA=CI(.95).

T-TEST GROUPS= Regiemissing(0 1)

/MISSING=ANALYSIS

/VARIABLES= AGE

/CRITERIA=CI(.95).

\* Kijken of er een significant verschil zit in geslacht, opleidingsniveau (SES) en ethniciteit tussen mensen die wel ingevuld hebben en niet - Categorische variabelen, dus crosstabs.

CROSSTABS

/TABLES=GENDER SEP ETHNI BY VUCAmissing

/FORMAT=AVALUE TABLES

/STATISTICS=CHISQ

/CELLS=COUNT COLUMN

/COUNT ROUND CELL.

CROSSTABS

/TABLES= GENDER SEP ETHNI BY Stressmissing

/FORMAT=AVALUE TABLES

/STATISTICS=CHISQ

/CELLS=COUNT COLUMN

/COUNT ROUND CELL.

CROSSTABS

/TABLES=GENDER SEP ETHNI BY Supportmissing

/FORMAT=AVALUE TABLES

/STATISTICS=CHISQ

/CELLS=COUNT COLUMN

/COUNT ROUND CELL.

CROSSTABS

/TABLES=GENDER SEP ETHNI BY Controlmissing

/FORMAT=AVALUE TABLES

/STATISTICS=CHISQ

/CELLS=COUNT COLUMN

/COUNT ROUND CELL.

\*Select cases with no missings on used variables. In total 44996 respondents.

USE ALL.

COMPUTE filter\_$=(NMISS(VUCA, Support, Control, Stress, SEP) < 1).

VARIABLE LABELS filter\_$ 'NMISS(VUCA, Support, Control, Stress, SEP) < 1 (FILTER)'.

VALUE LABELS filter\_$ 0 'Not Selected' 1 'Selected'.

FORMATS filter\_$ (f1.0).

FILTER BY filter\_$.

EXECUTE.

\*percentages VUCA, stress en verandering door covid.

\*\*\*Weegfactor aan/uit, zo kunnen we uitspraken doen over heel de regio.

WEIGHT BY ewGGDlang.

FREQUENCIES VARIABLES=Stress Controle Angstig Depressief Eenzaam Stressveran

/ORDER=ANALYSIS.

WEIGHT OFF.

--------------------------------------------------------------------------------.

\*run frequencies SEP groups.

FREQUENCIES VARIABLES= SEP

/ORDER=ANALYSIS.

\*Run descriptives/frequencies sorted by SEP groups.

\*Sort by SEP.

SORT CASES BY SEP.

SPLIT FILE LAYERED BY SEP.

\*Analyze frequencies by SEP.

FREQUENCIES VARIABLES= gender, ethni, stress

/ORDER=ANALYSIS.

\*Analyze descriptives by SEP.

DESCRIPTIVES VARIABLES= age, vuca, control, support

/STATISTICS=MEAN STDDEV MIN MAX.

\*End split file.

SPLIT FILE OFF.

\*Compare mean

ONEWAY VUCA BY SEP

  /STATISTICS DESCRIPTIVES

  /MISSING ANALYSIS

  /POSTHOC=BONFERRONI ALPHA(0.05).

\*correlations for correlation matrix.

CORRELATIONS

/VARIABLES=VUCA Stress Control Support SEP Age Gender

Ethni

/PRINT=TWOTAIL NOSIG

/MISSING=PAIRWISE.

---------------------------------------------------------------------------------.

\*Assumptions.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA COLLIN TOL

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT VUCA

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Stress, Control, Support, SEP

/RESIDUALS HISTOGRAM(ZRESID) NORMPROB(ZRESID)

/SAVE MAHAL COOK LEVER RESID.

\*Checken outliners, geen outliners te zien, want niet lager dan .0001.

COMPUTE Probability\_MAH\_1=1 - CDF.CHISQ(MAH\_1,9).

EXECUTE.

\*Zscores maken van Mah.

DESCRIPTIVES VARIABLES=MAH\_1

/SAVE

/STATISTICS=MEAN STDDEV MIN MAX.

-------------------------------------------------------------------------------.

\*analyses

H1.

\*model 1 & model 2.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT VUCA

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Stress.

\*Model 3.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA COLLIN TOL

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT VUCA

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Stress, Control, Support, SEP.

\*H2.

PROCESS, so no syntax.

\*H3.

\*Z scores maken.

DESCRIPTIVES VARIABLES=Stress Support

/SAVE

/STATISTICS=MEAN STDDEV MIN MAX.

\*Maken van moderator.

COMPUTE Moderator=ZStress \* ZSupport.

EXECUTE.

\*moderatie analyse.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT VUCA

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Stress Support

/METHOD=ENTER Moderator.

\*De visualisatie voor moderatie van sociale support. Maar niet significant.

DATA LIST FREE/

Stress Support VUCA .

BEGIN DATA.

1,0000 5,0220 4,5658

1,6734 5,0220 4,6685

2,4518 5,0220 4,7872

1,0000 8,0802 4,4167

1,6734 8,0802 4,5063

2,4518 8,0802 4,6098

1,0000 11,0000 4,2743

1,6734 11,0000 4,3514

2,4518 11,0000 4,4405

END DATA.

GRAPH/SCATTERPLOT=

Stress WITH VUCA BY Support .

\*SEP ANALYSES.

\*H4a.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT Stress

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER SEP.

\*H4b.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT VUCA

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER SEP.

\*H4c.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT Control

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER SEP2.

\*H4d.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT Support

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER SEP.

------------------------------------------------------------------------------------------------------.

\*Aanvullende analyses.

\*regression with support predicting stress.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT Stress

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Support.

\*regression with support predicting perceived control.

REGRESSION

/MISSING LISTWISE

/STATISTICS COEFF OUTS R ANOVA CHANGE

/CRITERIA=PIN(.05) POUT(.10)

/NOORIGIN

/DEPENDENT Control

/METHOD=ENTER Age Gender Ethni

/METHOD=ENTER Support.

1. Socioeconomic position (SEP) is the social standing of an individual or group often measured with education, income and occupation (Baum et al., 2006) [↑](#footnote-ref-1)
2. An analysis, comparing socio-demographic characteristics of the excluded group of participants to those included in the analyses, showed that the missings were not random. Specifically, people with missings were in general lower educated. [↑](#footnote-ref-2)
3. Weighted percentages have been used to make statements about the population of Utrecht region. Weighting is not applied in the rest of the analyses. [↑](#footnote-ref-3)