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Short communication

Maternal depressive symptoms and infant temperament in the first year of life predict child behavior at 36 months of age

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ABSTRACT

In a longitudinal study, mothers (N = 50) self-reported on their depressive symptoms (DS) and their child's behavior during the first year and at 36 months postpartum. Maternal DS during infancy were associated with child conduct problems (CP), suggesting a long-term association between maternal mental health and the development of child behavior. Infant temperament was also associated with child behavior so that negative affect predicted child CP, while infant surgency was associated with later hyperactivity-inattention. This study contributes to the literature by jointly assessing the role of maternal DS and infant temperament and showing that these are independent predictors of childhood behavior.

1. Introduction

Maternal depression has been associated with long-term negative effects on the mother as well as on her child. Risks of sub-optimal child developmental outcomes range from insecure attachment to behavioral problems and higher levels of psychiatric disorders (e.g., Beck, 1996, 1998; Murray, Halligan, & Cooper, 2010). Recent evidence has shown that exposure to maternal depressive symptoms (DS) predicts infant negative affect (NA) (i.e., a tendency to experience and express the emotions of frustration/anger, fear, and sadness; Goldsmith et al., 1987) and child behavioral and emotional problems even when maternal symptom severity is low (e.g., Cents et al., 2013; Shapiro, Jolley, Hildebrandt, & Spieker, 2018). For example, Cents et al. (2013) showed that, while 3-year-old children of mothers with high DS from pregnancy to 3 years postpartum were more likely to have internalizing and externalizing problems than children of mothers with low symptoms, even children of mothers with subclinical symptoms had significantly more problem behaviors than those reporting very few or no symptoms. Likewise, Giallo, Woolhouse, Gartland, Hiscock, and Brown (2015) found no significant differences in the levels of emotional and behavioral difficulties of 4-year-old children of mothers reporting subclinical DS and those with increasing and persistently high symptoms from pregnancy to 4 years post-partum. Both these groups of children were more likely to have emotional and behavioral difficulties in the 'at risk' or 'clinical' range compared to children of mothers reporting no or minimal symptoms. Furthermore, postnatal maternal depression (and prenatal anxiety) has recently been found to predict poor child attention at 2 years of age (Ross, Letourneau, Climie, Giesbrecht, & Dewey, 2020).

Importantly, infant temperament has also been suggested to contribute to cognitive, emotional and behavioral development at preschool and school age (e.g., Frick et al., 2018; Halpern, Garcia Coll, Meyer, & Bendersky, 2001; Lemelin, Tarabulsy, & Provost, 2006).

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For example, Lawson and Ruff (2004) provided evidence that early attentiveness and negative emotionality (a broad construct referring to the tendency to show various forms of negative affect such as generalized distress, fear and anger; Bates, 1989) at 1 and 2 years of age were associated with later cognitive function and behavioral problems at 3.5 years. In line with previous literature (e.g., Bates, Maslin, & Frankel, 1985), early negative affect (NA) in particular predicted higher ratings for later overall behavior problems (Lawson & Ruff, 2004).

There are also indications that positive affectivity dimensions of infant temperament are linked to later prosocial behavior (e.g., Stanhope, Bell, & Parker-Cohen, 1987; Young, Fox, & Zahn-Waxler, 1999), and studies with older children typically report associations between temperament dimensions such as low reactivity and high self-regulation and prosocial behavior and social competence (for a review, see Sanson, Hemphill, & Smart, 2004). Surgency is one of those dimensions associated with expressions of positive emotions, and, together with NA and Orienting/Regulatory Capacity (ORC, referred to as Effortful Control in children), is considered a core temperament dimension that appears in infancy and develops throughout childhood and adolescence (Rothbart, 2011; for a review, see Holmboe, 2016). A young infant with high levels of Surgency may develop into a very sociable child and adult (Putnam, Ellis, & Rothbart, 2001). However, exuberant children may also struggle to control their impulses when needed (Rothbart, Derryberry, & Hershey, 2000). Children's Effortful Control (i.e., the ability to plan and suppress an inappropriate response and/or to maintain attentional focus on a task; Rothbart, Ahadi, & Hershey, 1994) has also been found to contribute to positive outcomes in children, such as the ability to manage emotions, plan behavior, and engage in socially appropriate behavior (e.g., Eisenberg, Hofer, & Vaughan, 2007). In line with these findings, in a longitudinal study with 18- to 30-month-old toddlers, Spinrad et al. (2007) found that children high in Effortful Control were lower in externalizing problems and separation distress, and higher in social competence.

Altogether, this body of evidence shows important influences of maternal mental health and early temperament characteristics on later child behavior, however, the vast majority of the existent studies have not addressed both of these key factors within the same study. Furthermore, very few studies have investigated these questions systematically during the very earliest stages of life, when maternal mental health and infant temperament are strongly and dynamically associated (e.g., Dix and Yan, 2014). One study that did look at these factors from early in life found that maternal DS in the first 2 years postpartum predicted greater risk for adjustment problems in 3-year-old children who as infants were high in negative emotionality (Dix and Yan, 2014). These authors reported negative parenting as a mediator of this effect, i.e., the stronger mothers' depressive symptoms, the more they responded to children high in negative emotionality with negative parenting. However, this study only included infant data collected at a single point in infancy (at 6 months). The current study investigates the role of both infant temperament and maternal mental health, collected at multiple time points during the first year of life, in relation to later childhood outcomes. This approach represents an essential step for developing timely support and intervention programs for new parents and their children.

1.1. The current study

The current study is a follow-up to a previous longitudinal study which revealed cascading associations between maternal DS and infant NA across the first 9 postpartum months ((Rigato, Stets, Bonneville-Roussy, & Holmboe, 2020); see Table S1 in Supplementary material for correlations between maternal DS and infant NA). Identical questionnaires were used at four age points after birth (two weeks after birth, 4 months, 6 months and 9 months of age) to assess maternal DS and infant NA, i.e., the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) and the Infant Behavior Questionnaire – Revised, Very Short Form (IBQ-R VSF; Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2014). In the current study, we investigated how these measures of maternal DS and infant temperament are related to later developmental outcomes at 36 months of age in the same cohort. Since existing evidence suggests that not only NA but also other dimensions of infant temperament are linked to childhood behavior (e.g., Stanhope et al., 1987; Young et al., 1999), infant Surgency and ORC were also analysed. Mothers were asked to complete the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) to report their child's behavior, as well as the BDI-II to report their own DS, when the child was 36-month-old.

Given the stability of BDI-II and IBQ-R VSF scores across the first postnatal year (see (Rigato et al., 2020)), these were averaged across time-points, and the means used in the analyses. (It should be noted that data from the Surgency scale at 2 weeks of age were excluded, as parents rated the vast majority of the Surgency items as 'Not Applicable' at this age.) Using the mean scores in our correlational analyses provided a more stable measure, less influenced by fluctuations at a single time point, and reduced the number of statistical comparisons, and therefore the risk of spurious associations. Based on the literature reviewed above, we anticipated more emotional and behavioral problems in children of mothers with higher DS, and in those children with higher NA in infancy. We first conducted bivariate correlation analyses to establish whether the expected associations between maternal DS, infant NA and later behavioral difficulties were indeed present. The Benjamini-Hochberg (1995) false discovery rate method was applied for multiple comparisons. When significant correlations where found, we followed up these analyses with linear regression analyses where we specifically tested the effect of maternal DS, infant NA, and their interaction, on child behavioral problems, as assessed by the SDQ. We also expected positive associations between infant Orienting/Regulatory Capacity and child Prosocial behavior. As the literature suggests that infant Surgency can be associated with both child social behavior but also difficulties in controlling impulses, we expected positive correlations between Surgency and the Prosocial behavior and Hyperactivity-Inattention SDQ subscales.

2. Method

2.1. Participants

A total of 63 mothers who took part in the original study and recruited from the general population ((Rigato et al., 2020); see

Supplementary material for further information on the participants) were contacted via email or phone two weeks ahead of their child's third birthday. Of these, fifty mothers completed the questionnaires when their child was 36-month-old (average: 1120 days; SD: 45 days). A power of analysis conducted in G*Power established that the sample size of the current study was adequate. The analysis indicated that 46 participants were needed to detect an effect of $r = .39$ (based on the previously reported association between maternal DS and infant NA in the first year of life, (Rigato et al., 2020)) with 80% power and a two-tailed alpha level of.05.

Prior to accessing the questionnaires, a consent form was displayed to which the participant had to agree in order to take part in the study. Ethical approval was gained from the University of Essex Ethics Sub-Committee (ID SR1901). All data were collected before the COVID-19 pandemic.

2.2. Measures

Details on each of the questionnaires which are the focus of this article are provided below. Analyses of an additional measure, the Very Short Form of the Children's Behavior Questionnaire (CBQ-VSF, Putnam & Rothbart, 2006), can be found in the Supplementary material.

2.2.1. The Infant Behavior Questionnaire–Revised very short form (IBQ-R VSF)

In the original study, to investigate the developmental trajectories in infant temperament, mothers completed the IBQ-R VSF (Putnam et al., 2014), consisting of 37 items in total, separated into three broad subscales. Cronbach's alpha measured at the different timepoints for the NA scale ranged from.77 to.88 across ages (M=.81), for the Surgency scale it ranged from.70 to.91 (M=.80; excluding the scale at 2 weeks), and for the ORC scale it ranged from.62 to.80 (M=.72).

2.2.2. The Strengths and Difficulties Questionnaire (SDQ)

To investigate the child's behaviors, emotions and relationships, mothers were asked to complete the SDQ (Goodman, 1997). This consists of 25 items separated into 5 subscales. In the current study, Cronbach's alpha for the five SDQ subscales were as follows:.65 for Emotional Symptoms,.43 for Conduct Problems,.71 for Hyperactivity-Inattention,.52 for Peer Problems, and.74 for Prosocial Behavior. It should be noted that Cronbach's alpha was acceptable for all subscales in the large validation sample of 5- to 15-year olds in Goodman (2001). The lower alpha for some SDQ scales in our sample could be due to younger children showing less differentiation of behavioral problems. Furthermore, given that all the subscales, except for the Hyperactivity-Inattention scale, were not normally distributed (see Table S11), the lower alphas could also reflect low variance of symptoms in the population sampled, although Goodman et al. (2001) also assessed a general population sample.

2.2.3. The Beck Depression Inventory-II (BDI-II)

To assess mothers' level of depressive symptoms over the course of their infant's first year (at four time-points) and at 36 months postpartum, we asked them to complete the BDI-II (Beck et al., 1996), consisting of 21 items. In the current study, Cronbach's alpha for BDI-II scores across ages ranged from.87 to.94 (M=.92).

3. Results

3.1. Descriptive statistics

Means and standard deviations for IBQ-R VSF subscale scores averaged across infancy are presented in Table 1. Table 2 provides an overview of BDI-II average scores across infancy and at 36 months postpartum; these are below the cut-off for clinical depression. Means and standard deviations for SDQ subscales at 36 months of age are presented in Table 3. Table S2 shows the breakdown of average scores for IBQ-R VSF subscales. Table S3 shows the breakdown of average scores at each maternal depression level for the BDI-II at each age point in the original infant study. CBQ-VSF scores and analyses are included in the Supplementary material.

3.2. Correlations

Spearman correlations were run to investigate the associations between maternal DS and infant temperament in the first year of life and child behaviors at 36 months. Significant associations are depicted in Fig. 1. Maternal DS across the first year postpartum was found to strongly correlate with maternal DS 36 months postpartum, $r = .573$, $p < .001$. Maternal DS in infancy was significantly associated with child Conduct Problems (CP), $r = .448$, $p = .001$. No further associations were found between BDI-II scores and the

Table 1
Mean scores (SD) for Infant Behavior Questionnaire - Revised Very Short Form (IBQ-R VSF) subscale scores averaged across infant stages of the study for the participants who also contributed data at 36 months of age (N = 50). (It should be noted that the data for Surgency at 2 weeks of age were excluded from the average, as the vast majority of items for this scale were rated as 'Not Applicable' by parents of infants this young.).

	Negative affect	Surgency	Orienting/Regulatory capacity
Average across ages (0–9 months)	3.80 (0.75)	4.30 (0.76)	5.08 (0.69)

Table 2
Maternal mean scores (SD) on the Beck Depression Inventory-II (BDI-II) averaged across infant stages of the study for the participants who also contributed data at the 36-months assessment point (N = 50).

	Average across ages (0–9 months)	36 months postpartum
Mean Scores (SD) for Maternal BDI-II	8.70 (6.63)	9.30 (9.95)

Table 3
Mean scores for each Strengths and Difficulties Questionnaire (SDQ) subscale at 36 months of age.

	Emotional symptoms	Conduct problems	Hyperactivity-Inattention	Peer problems	Prosocial behavior
Mean Scores (SD)	1.20 (1.44)	2.46 (1.03)	3.68 (1.78)	2.96 (1.73)	7.22 (1.80)

other SDQ subscales. Infant NA correlated with CP at 36 months, r = .404, p = .004, infant Surgency correlated with Hyperactivity-Inattention, r = .399, p = .005, and Orienting/Regulatory Capacity correlated with child Prosocial behavior, r = .314, p = .027 (see Table 4). Tables S4 and S5 report the correlations between maternal BDI-II scores and infant IBQ-R VSF scores at each time point included in the original study and child SDQ scores.

3.3. Linear regression

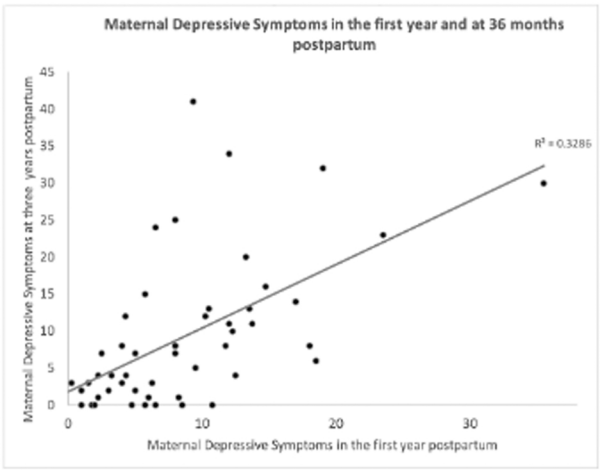
Given the significant correlations between infant NA and maternal DS with CP at 36 months, a linear regression was run to test whether child CP was primarily predicted by infant NA, maternal DS or their interaction. Bivariate correlations determined that there were no associations between key demographics (maternal age and years in education) and the measures of interest (all *ps* > .18; see Table S6). Therefore demographic variables were not included in the regression analysis. Infant NA, maternal DS scores (both averaged across the first year) and their interaction were entered as predictors for this analysis. In order to reduce multicollinearity, centered variables were used in our model (Iacobucci, Schneider, Popovich, & Bakamitsos, 2017). The regression was significant ($F(3,46) = 4.524$, p = .007), with an $R^2 = .228$. We found that infant NA and maternal DS independently predicted child CP, p = .045 and p = .014, respectively, but not their interaction, p = .117 (Table 5).

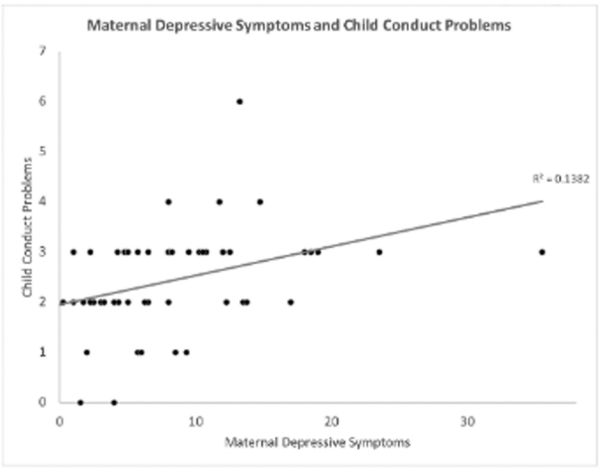
4. Discussion

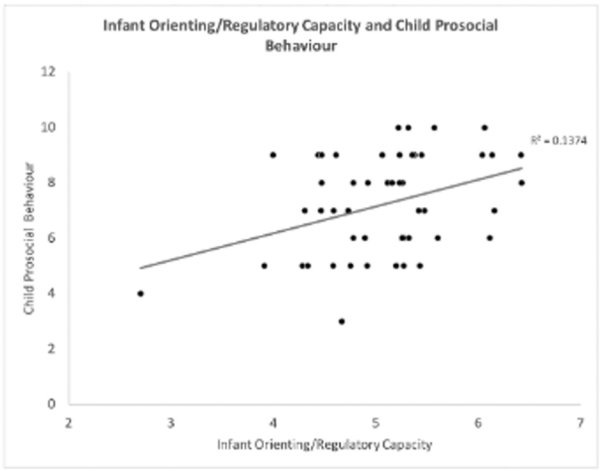
The current study is one of the very few that systematically investigates the associations that exist between maternal DS and infant temperament in the first year of life and later child behavioral outcome. We found that maternal DS in the first year postpartum is not only significantly associated with infant NA ((Rigato et al., 2020)), but also with CP at 36 months of age. This is particularly striking given that the sample of mothers in this study was recruited from the general population and mothers were not clinically depressed. This evidence, which is in line with previous studies (Cents et al., 2013; Giallo et al., 2015) indicating adverse effects of maternal DS on child behavior - even when DS are low in severity – highlights the need for the healthcare system to focus not only on clinically depressed mothers, but also on that considerable proportion of women who experience subclinical postnatal depressive symptoms, most likely undetected by practitioners.

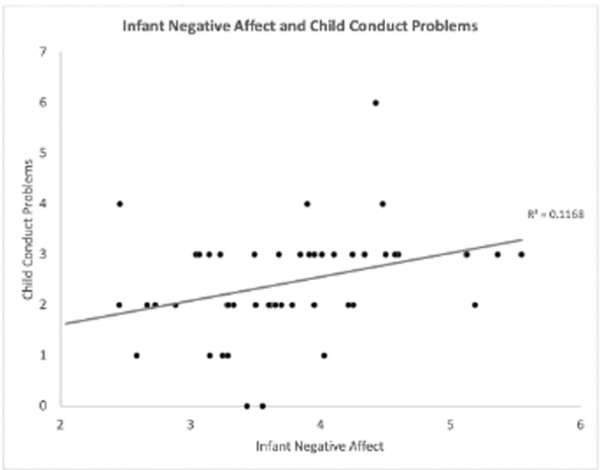
Our findings also extend the literature on the associations between infant temperament and later behavior by showing that both positive and negative affectivity dimensions of early infant temperament, as well as regulatory factors, influence behavior development at pre-school age. Specifically, we found that NA in infancy predicted CP at 36 months, highlighting the importance of identifying those infants who struggle in the first postnatal year and the need for developing interventions that can support optimal child development as early as possible. While the finding that early NA predicts later overall behavior problems is in line with previous research (e.g., Bates et al., 1985; Lawson & Ruff, 2004), it is interesting to note that in our study infant NA did not predict other problematic outcomes, such as emotional symptoms or peer problems, possibly indicating a specific association between strong emotional reactivity in infancy and CP at pre-school age. Finally, the significant correlation between Surgency and Hyperactivity-Inattention suggests that those babies who express more positive emotions and approach behaviors are those who as pre-schoolers are perceived as more restless and easily distracted. While we also anticipated a correlation between Surgency and Prosocial behavior, this only showed a significant trend ($p = .057$). Overall, these results are in line with observations that while infants with high levels of Surgency may develop into very sociable children (Putnam et al., 2001), because of their exuberance they may also struggle to control their impulses (Rothbart et al., 2000). Child Prosocial behavior was significantly associated with Orienting/Regulatory Capacity in the first year of life, however, while this is consistent with previous findings in 18- to 30-month-old toddlers (Spinrad et al., 2007), we note that in our study this association did not survive correction for multiple comparisons and was due to a significant correlation with Orienting/Regulatory Capacity at 2 weeks of age only (see Table S4).

While these findings confirm existent evidence on the influences of maternal mental health and early temperament characteristics on later child behavior, our study represents an important contribution to the literature by providing a comprehensive and systematic assessment of both maternal DS and infant NA during the very earliest stages of life. Collecting both measures during infancy in the









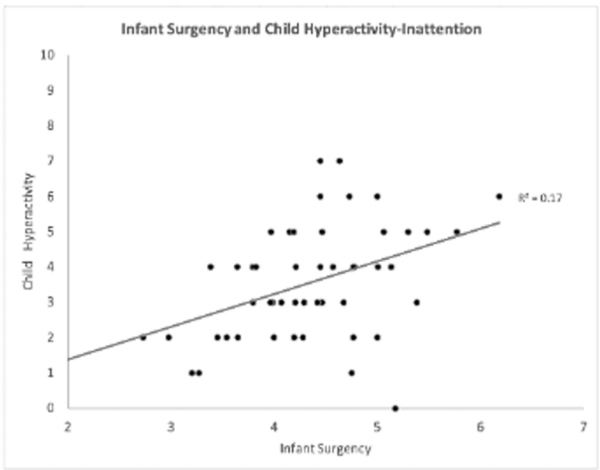


Fig. 1. Significant correlations between maternal depressive symptoms (DS) and infant temperament in the first year of life and child behaviors at 36 months. Maternal DS were assessed with the Beck Depression Inventory-II (BDI-II), infant temperament was assessed with the Infant Behavior Questionnaire – Revised Very Short Form (IBQ-R VSF), and child behavior was assessed with the Strenghts and Difficulties Questionnaire (SDQ).

Table 4
Spearman correlations between the Infant Behavior Questionnaire – Revised Very Short Form (IBQ-R VSF) subscale scores (averaged across infancy) and Strengths and Difficulties Questionnaire (SDQ) subscale scores at 36 months of age. Significant cross-measure correlations are in bold. Note: $^{**}p < .01$, $^{*}p < .05$, two-tailed p-values. ** p values remained significant after correction for multiple comparisons using the Benjamini-Hochberg (1995) false discovery rate.

	Emotional symptoms	Conduct problems	Hyperactivity-Inattention	Peer problems	Prosocial behavior
Infant Negative Affect	.054	**.404** * *	.100	.070	.123
Infant Surgency	-.100	.101	**.399** * *	.217	.274
Infant Orienting/Regulatory Capacity	-.054	-.200	-.110	-.035	**.314** *

Table 5
Prediction of child conduct problems (as measured by the Strengths and Difficulties Questionnaire) by maternal scores (SD) on the Beck Depression Inventory-II (BDI-II), infant negative affect (as measured by the Infant Behavior Questionnaire – Revised Very Short Form), and their interaction.

	Child conduct problems				
	B (SE)	β	t	Sig.	95.0% Confidence Interval for B
Maternal BDI-II	.067 (.026)	.433	2.564	.014	.014 – .12
Infant Negative Affect	.417 (.212)	.301	2.06	.045	.01 – .824
Maternal BDI-II by Infant Negative Affect Interaction	-.049 (.03)	-.278	-1.596	.117	-.11 – .013

same study, allowed us to investigate both independent effects and their interaction in relation to child behavioral outcome. Our analyses revealed significant effects of maternal DS and infant NA on child CP. However, in the current study there was no interaction between these two factors, suggesting relatively independent effects of maternal DS and infant NA on later conduct problems. Supplementary analyses showed that when maternal DS at 3 years postpartum were also entered as a predictor in the model, infant NA remained the only significant predictor (Table S10). This is in contrast to Dix & Yan's (2004) study which demonstrated that maternal DS were more likely to affect adjustment problems of pre-school children who were high in negative emotionality at 6 months of age. The lack of interaction in the current study could be due to our modest sample size or the lack of high maternal DS scores. More research on potential interactive effects of infant temperament characteristics and maternal DS on childhood behavioral outcomes is therefore needed.

Certain limitations of the current study must be noted. For example, the study relied on self- and parent-report questionnaire data, it had a relatively modest sample size, alphas for some SDQ scales were low, and maternal prenatal mental health information was not available. The findings of the current study would be strengthened if replicated with multi-informant and observational measures in a larger sample in the future. Despite these limitations, with the present study we extend the current literature by showing that maternal mental health and infant temperament in the first year of life are both important independent predictors of childhood behavior, and that characteristics of both negative and positive affect during infancy are associated with specific aspects of behavior in pre-school children.

Declaration of Competing Interest

The authors declare no conflict of interest with regard to the funding source for this study.

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Research data for this article

Anonymized individual scale scores for the questionnaires will be made openly available via OSF upon publication.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.infbeh.2022.101717.

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