



A French Version of the Action Control Scale (ACS-Fr): Psychometric Properties and Predictive Power

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RESEARCH

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ABSTRACT

This article presents four studies. Study 1 reports the development and psychometric properties of a French version of the Action Control Scale (ACS-Fr) (Kuhl, 1994a)—a frequently used instrument for assessing individual differences in action-state orientation in self-regulation. Studies 2–4 tested the predictive power of the ACS-Fr regarding individuals' ability to escape from rumination, initiate action, and maintain goal-directed behavior—three major components of efficient action control. In Study 1, confirmatory factor analysis revealed a revised three-factor model (with 24 items) fitting the scale's structure well. Regression analyses suggest convergent validity of the ACS-Fr in terms of associations with related self-regulation capacities and problems and a moderate overlap with the Big Five global personality traits. Further speaking for the ACS-Fr validity and its predictive power, we found preliminary evidence that action-oriented individuals ruminated less (Study 2), engaged in action more easily (Study 3), and persisted longer in a cognitive control task (Study 4) than state-oriented people.

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1. INTRODUCTION

Action Control Theory (Kuhl, 1982, 1983, 1986, 1994a) posits that people who initiate and execute intended actions have to cope with various external and/or internal distractors and obstacles. This can result in disengagement if individuals do not possess the necessary abilities to protect themselves against interferences in goal-directed action. Kuhl posits differences in individuals' ability to *plan*, *initiate*, and *complete* intended actions, reflecting three core aspects of volition—i.e. action control. Action initiation and shielding is also central in other models, such as the Mindset Theory of Action Phases (Gollwitzer, 1990). However, Action Control Theory (Kuhl, 1994a) emphasizes the role of individual differences in these capacities: individuals are posited to differ in their stable disposition to be rather state- or action-oriented (Koole et al., 2006; Kuhl, 1982). More action-oriented individuals stay focused on and committed to their goals and invest resources in goal pursuit—also in face of difficulties. These persons are also more flexible in regulating their attention and affect. By contrast, individuals who are more state-oriented tend to procrastinate and/or ruminate, which decreases attention to their goals and resource investment in goal pursuit (Kuhl, 1994b). These individual differences in action control have important effects on whether and how people engage in and execute everyday goal-directed actions. When facing difficulties—e.g., temptations, distractions, negative feelings, or obstacles—action-oriented individuals are posited to initiate and maintain goal directed action, whereas state-oriented persons are more prone to procrastinate and disengage, and thus more likely to fail. A more detailed discussion of the many and important effects of being more action- or state-oriented on self-regulation has been provided by Koole et al. (2012).

Kuhl (1994b) developed a self-report questionnaire—the Action Control Scale (ACS-90)—for assessing individuals' abilities regarding the three central aspects of volition stated above. More action-oriented individuals should have less ruminative thoughts, show more action initiation towards specific goals, and higher persistence in goal pursuit than more state-oriented persons (see Kuhl, 1994a). Indeed, action-state orientation assessed with the ACS-90 advanced the understanding of individual differences in many areas, such as ADHD symptoms (Edel et al., 2009), language learning (MacIntyre & Blackie, 2012), memory processes (Kaschel et al., 2017; Kaschel & Kazén, 2018), creativity (Weinzimmer et al., 2011), goal-striving (Koole et al., 2012; Schlinkert & Koole, 2018), and affect-regulation (Kazén et al., 2015; Landman et al., 2016; Lüdecke & Baumann, 2015)—to name a few. Assessing individual differences in action-state orientation permits better understanding behavioral differences between people. It can, for instance, explain why some individuals manage

to reach rather difficult goals whereas others fail or why some individuals cannot stop ruminating whereas others simply move on. The ACS-90 allows to assess how volitional processes influence individuals' action control beyond the factors that drive them to act (e.g., their needs or desires).

1.1 THE ACTION CONTROL SCALE

The ACS-90 aims at measuring individual differences in volition—persons' ability to form and maintain intentions and to execute goal-directed actions (Kuhl, 1994b). Built on a continuum, the scale permits identifying individuals who are more *action-oriented* vs. more *state-oriented*. The general action-state orientation construct can be divided into three sub-dimensions (Kuhl, 1994b), namely Preoccupation/Disengagement, Hesitation/Initiative, and Volatility/Persistence, which are related to different volition aspects. The *Preoccupation/Disengagement* dimension refers to the way individuals process information and think about the past, the present, and the future. This refers to the time preceding goal-directed action execution. The *Hesitation/Initiative* dimension refers to individual differences in the ability to initiate intended actions. The *Volatility/Persistence* dimension concerns individual differences in the ability to maintain goal pursuit after its initiation.

Each subscale comprises 12 items (36 in total) describing everyday life scenarios. Respondents choose between two response alternatives (A or B) illustrating what they would do (see Appendix). Each response is scored either 0 or 1; 0 corresponds to the state-oriented and 1 to the action-oriented alternative in each scenario. To avoid position effects, the order of state- and action-orientation related answer alternatives varies. The entire ACS-90 scores range from 0 to 36 points; each subscale score ranges from 0 to 12 points. Higher scores reflect a higher action-orientation.

1.2 ACTION CONTROL, SELF-REGULATION, AND PERSONALITY MEASURES

Kuhl (1994a) has linked action control with other self-regulation and personality variables.¹ Preoccupation has been related to rumination and hesitation partly corresponds to procrastination (Beswick & Mann, 1994). Diefendorff et al. (2000) tested for associations between the ACS-90 and other self-regulation capacities and problems. The ACS-90 was significantly related to depressive symptoms, cognitive failures, intrusive thoughts, and self-consciousness, reflecting associations between high state-orientation and these individual difference variables. Additionally, Diefendorff et al. (2000) tested for relations of the action-state construct with global personality traits assessed with the Big Five personality inventory (Barrick & Mount, 1991). Despite a significant overlap, most of the variance remained unexplained, suggesting that the ACS-90 covers unique

variance that is not explained by global traits. Thus, it is a useful tool for better understanding individual differences in self-regulation and action control. However, it remained open whether this only applies to the scale's English (Diefendorff et al., 2000) and German (Kuhl, 1994b) versions.

1.3 THE PRESENT RESEARCH

To date, a validated version of the ACS-90 for French-speaking populations is still missing. Consequently, we developed a French version of the ACS-90, namely the ACS-Fr. In Study 1, we tested its factor structure, internal validity and links with other self-regulation abilities, and global personality traits. Studies 2 to 4 examined the predictive power of our new 24-item ACS-Fr scale.

2. STUDY 1: THE ACS-FR

After translation of the ACS-90 (Kuhl, 1994b) into French (see below), we followed the Diefendorff et al. (2000) procedure for the English version and conducted CFAs to test the ACS-Fr's convergent and divergent validity. To compare our findings with those of the validation of the English ACS-90, we used validated French versions of scales assessing the same constructs as Diefendorff et al. (2000): the *Revised Self-Consciousness Scale (R-SCS)* (Pelletier & Vallerand, 1990), the *Test for Ability to Study and Evaluation scale (TASTE)* (Masson et al., 2001), the *Internal, Powerful Others, and Chances questionnaire (IPC)* (Rossier et al., 2002), and the *Center for Epidemiologic Studies Depression Scale (CES-D)* (Fuhrer & Rouillon, 1989). Given that higher ACS scores indicate higher action-orientation, we expected the ACS-Fr—particularly the Preoccupation/Disengagement and the Hesitation/Initiative subscales—to be negatively related to the R-SCS (Pelletier & Vallerand, 1990) and the two TASTE subscales (Masson et al., 2001): the Test Anxiety subscale should be negatively related to Preoccupation/Disengagement; Procrastination should be negatively associated with Hesitation/Initiative. Depressive symptoms (CES-D, Fuhrer & Rouillon, 1989) were expected to be negatively linked to Preoccupation/Disengagement and Hesitation/Initiative. Moreover, all ACS-Fr subscales should be positively related to the Internal subscale of the IPC (Rossier et al., 2002).

Finally, we tested for associations of the ACS-Fr with the *NEO Five-Factor Inventory (NEO-FFI)* (Rolland et al., 1998) and expected—again based on Diefendorff et al. (2000)—that, despite significant associations, most of the variance would not be shared.

2.1 MATERIALS AND METHOD

2.1.1 ACS-Fr Translation Procedure

We tried to translate the ACS-Fr items into French as literally as possible. We first translated the English

version into French and conducted a legibility test with 10 French native speakers. Next, two trilingual persons received the French translation and the English and German versions of the ACS-90. After verification of the French translation, they compared it with the original German and English versions. This latter step resulted in some minor reformulations due to idiosyncrasies in the French language (see Table S1 in the ESM). The final full version of the ACS-Fr appears in the Appendix.

2.1.2 Participants and Procedure

Complying with Kyriazos' (2018) recommendation of a minimal sample size of $N = 200$ for CFA analyses, we invited 350 first year psychology Bachelor students to participate in this study at the beginning of their first semester at the University of Geneva. A total of $N = 288$ students (240 women, 48 men; average age 21 years) responded favorably and received partial credit for practical course-related work. Participants completed the ACS-Fr together with 5 other questionnaires (see details below in the Materials section) to assess its convergent and discriminant validity. Because of time restrictions, participants completed the CES-D in an extra-session. $N = 224$ students responded to this latter questionnaire.

2.1.3 Measures

Beside the ACS-Fr, participants completed computerized French versions of 5 questionnaires on individual personal computers in group sessions. These questionnaires were selected to mirror the former work by Diefendorff et al. (2000) and to be able to compare our results with it. Sample items and the methods for the calculation methods of these scales' scores are available in the ESM. Four of these questionnaires were related to self-regulation processes: (1) the R-SCS (Pelletier & Vallerand, 1990) refers to self-rumination and consists of 22 items divided into 3 subscales assessing individual differences in private and public self-consciousness (rating scales: 0 – *not at all similar to me* to 3 – *very similar to me*). (2) the TASTE (Masson et al., 2001) includes 5 subscales measuring individual differences in the ability to study and stand evaluations. For our purpose, we only administered the Test Anxiety and Procrastination subscales (10 items each; 1 – *almost never* to 5 – *most of the time*). (3) the IPC (Rossier et al., 2002) comprises 24 items assessing individual differences in the locus of control to which people attribute their own behavior (–3 – *totally disagree* to +3 – *totally agree*). Internal individuals feel mastery of their own actions, whereas External individuals attribute their behavior to uncontrollable circumstances. (4) the CES-D (Fuhrer & Rouillon, 1989) has 20 items and was developed to assess depressive symptoms in the general population (0 – *rarely* to 4 – *most of the time*). (5) The fifth questionnaire was the NEO-FFI (Rolland et al., 1998), which comprises 60 items to assess 5 global personality traits (Neuroticism, Extraversion, Openness,

Agreeableness, and Conscientiousness) (0 – *totally disagree* to 4 – *totally agree*).

2.1.4 Data Analysis

Based on Kuhl's (1994b) model and the Diefendorff et al. (2000) findings, we conducted 3 confirmatory factor analyses (CFAs) of the 36 ACS-Fr items to test whether a 1-, 2- or 3-factor solution would provide the best model fit. A 1-factor model should reflect a general action-state orientation factor; a 2-factor model should advocate for a distinction between the abilities to escape from a state-oriented mode vs. to stay in an action-oriented mode; a 3-factor model should reflect the three dimensions posited by Kuhl (1994b). For a more detailed discussion on the theoretical logic behind these 3 models, see Diefendorff et al. (2000). We fixed the items to factors a priori and allowed latent factors to correlate for the two latter models. Given that the answers to the ACS-Fr items are dichotomous, we used the Lavaan library (latent variable analysis) on R (Rosseel, 2018). The model parameters were estimated using diagonally weighted least squares (DWLS). We then assessed the goodness-of-fit of the models with several indices: the χ^2 test (non-significance indicates an adequate fit), the χ^2/df ratio, the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), and the chi-square difference test (χ^2_{diff}). We considered a χ^2/df ratio <2 to fit the data well; cut-off values for RMSEA were <.06, for SRMR <.09, for both CFI and TLI >.96 (Hu & Bentler, 1999). These cut-off criteria were chosen because decisions based on combined criteria should result in the lowest rates of Type I and Type II errors (see Hu & Bentler, 1999, for more details). Significant χ^2_{diff} tests would advocate for a bigger model. Second, we tested the construct validity of the ACS-Fr with multiple regression analyses. Specifically, we used the ACS-Fr subscales scores (see "The Action Control Scale" section for details) as predictors of the *R-SCS*, the *TASTE*, the *IPC*, and the *CES-D* scores. Third, we tested for associations between the ACS-Fr and global traits with the 5 *NEO-FFI* subscales as predictors of the ACS-Fr scores.

2.2 RESULTS AND DISCUSSION

2.2.1 Confirmatory Factor Analyses of the ACS-Fr

Results for the 1-, 2- and 3-factorial models (Models 1a, 2a, 3a) appear in Table S2 in the ESM. All models' chi-square tests were significant, the 3-factorial model showed a partially acceptable goodness-of-fit according to our criteria. Significant chi-square difference tests advocated for the 3-factorial model ($\chi^2_{diff} > 42.40$, $ps < .001$). However, a closer look at the CFAs' factor loadings revealed some imperfections (e.g., low factor loadings of some items). We therefore decided to run an additional exploratory factor analysis (EFA), which confirmed our concern: Mirroring the CFAs' results, the

EFA's factor loadings of some items were relatively low (see Appendix). We thus eliminated all items with factor loadings <.25. Furthermore, some of the items were not discriminative and item 23 loaded high on the Preoccupation/Disengagement dimension although it should refer to the Hesitation/Initiative dimension. We thus ran three additional CFAs with the remaining 24 items, which met the EFA's factor loading and discrimination criteria. Instead of 12 items per subscale of the original ACS-Fr, our revised version comprises 10 items of the original Preoccupation/Disengagement subscale and 7 items of both the original Hesitation/Initiative and Volatility/Persistence subscales. Subscale scores were obtained by summing item scores, resulting in three distinct sum scores ranging from 0 to 7 (or 10) instead of 12 originally. Results corroborated the previous findings and further advocated for the revised 3-factorial model ($\chi^2_{diff} > 52.50$, $ps < .001$). Comparisons between the indices and all parameters favor the 24-item solution of Model 3b (see Table S2 in the ESM) and complied with Hu and Bentler's (1999) combined criteria of rejection. Correlations between original and revised factors were high (>.89) and correlations between the factors of the revised version are slightly lower reflecting a more independent measure of the underlying factors (see Table S3 in the ESM). Cronbach's α s appear in Table 2.

We generally replicated the findings for the English revised version of the ACS by Diefendorff et al. (2000)—75% of the retained items were identical with our version, whereas 25% of the items differ. Six items—2 per factor—appearing in the French version did not appear in the English one and 4 items of the English version did not appear in the French one.

2.2.2 The ACS-Fr, Self-Regulation Capacities, and Global Personality Traits

Zero-order correlations of the ACS-Fr subscales and self-regulation capacities and personality traits appear in Table S7 in the ESM. Results concerning self-regulation capacities are presented in Table 1. The associations between the ACS-Fr and other self-regulation capacity measures are mostly consistent with the findings for its English (Diefendorff et al., 2000; Kuhl, 1994b) and German (Kuhl, 1990) versions. Notably, although not very high, up to 15% of the variance was shared with the different self-regulatory scales, anxiety, self-consciousness, and depressive symptoms.

Results regarding global traits appear in Table 2 and generally corroborate those of Diefendorff et al. (2000). Additionally, our ACS-Fr explained more variance than the English version. The ACS-Fr and especially its Hesitation/Initiative subscale shares a non-negligible part of its variance with global personality traits. Nonetheless, the links between high state-orientation and Neuroticism and between high action-orientation and Conscientiousness speak for the ACS-Fr's validity.

DEPENDENT VARIABLE	N	α	STANDARDIZED REGRESSION COEFFICIENT							R ² (CIS)
			PREOCCUPATION	HESITATION	VOLATILITY					
R-SCS										
Public	288	.83	-.26***	-.25***	-.05	-.09	<.01	-.04	.08***	.08*** (.02; .14)
Private	288	.76	-.09	-.06	.03	.01	-.04	<.01	<.01	<.01 (.00; .02)
Social Anxiety	288	.82	-.30***	-.33***	-.19**	-.13*	<.01	.01	.16***	.14*** (.06; .21)
TASTE										
Test Anxiety	288	.81	-.36***	-.34***	-.03	-.02	-.11	-.08	.16***	.13*** (.06; .20)
Procrastination	288	.82	-.08	-.11*	-.26***	-.29***	-.06	-.03	.10***	.11*** (.05; .18)
IPC										
Internal	288	.42	.10	.14*	.16*	.15*	.10	.13*	.06***	.07*** (.02; .13)
Powerful Others	288	.67	-.14*	-.14*	-.18**	-.15*	-.09	-.11	.08***	.07*** (.02; .13)
Chances	288	.57	-.14*	-.14*	-.09	-.08	-.10	-.08	.05**	.04*** (<.01; .09)
CES-D	224	.93	-.23***	-.26***	-.21***	-.15*	-.05	-.05	.14***	.10*** (.03; .18)

Table 1 Cronbach's Alphas and Multiple Regressions of Self-Regulation Variables and the Original and Revised (in bold) Versions of the ACS-Fr.

Note: 95% CIs of standardized coefficient are available in Table S5 in the ESM.

* $p < .05$. ** $p < .01$. *** $p < .001$.

DEPENDENT VARIABLE	M	SD	α	STANDARDIZED REGRESSION COEFFICIENT					R ² (CIS)
				N	E	O	A	C	
Original 36 item version									
Preoccupation	4.67	2.74	.71	-.56***	.02	.03	-.06	-.08	.31***
Hesitation	5.57	2.92	.74	-.36***	<.01	<.01	-.06	.57***	.51***
Volatility	8.26	2.19	.54	-.19***	-.15*	.12*	<.01	.36***	.18***
Revised 24 item version									
Preoccupation	3.89	2.47	.72	-.53***	<.01	.02	-.09	-.09	.28*** (.18; .36)
Hesitation	2.68	2.12	.75	-.21***	-.05	-.03	-.02	.65***	.50*** (.41; .57)
Volatility	4.40	1.82	.60	-.17**	-.13*	.14**	-.10	.44***	.23*** (.14; .31)

Table 2 Cronbach's Alphas and Multiple Regressions of the Big Five global personality traits and the Original and Revised Versions of the ACS-Fr.

Note: N = 288. N = Neuroticism ($\alpha = .85$); E = Extraversion ($\alpha = .73$); O = Openness ($\alpha = .66$); A = Agreeableness ($\alpha = .76$); C = Conscientiousness ($\alpha = .86$).

Note: 95% CIs of standardized coefficient are available in Table S6 in the ESM.

* $p < .05$. ** $p < .01$. *** $p < .001$.

3. STUDY 2: PREDICTING THOUGHTS

This study tested the predictive power of the Preoccupation/Disengagement subscale of our new ACS-Fr, which should partly correspond to the rumination construct (Beckmann, 1994). According to Kuhl (1994a), more action-oriented individuals should report fewer intrusive and perseverating thoughts in face of failures and unpleasant events. They should disengage from a passive

ruminative mode and initiate behavior change (Kuhl, 1994b). We tested this in the context of the first lockdown during the COVID-19 pandemic (March-April 2020) and its impact on individuals' feelings of freedom. We expected that more action-oriented individuals—those scoring high on the Preoccupation/Disengagement subscale—would experience fewer perseverating thoughts about the negative lockdown aspects and would be more focused on present and future actions to cope with the situation.

3.1 MATERIALS AND METHOD

3.1.1 Participants and Design

This and the following studies tested directed hypotheses: the effect of one specific predictor—the repetitive relevant ACS-Fr subscale—on a conceptually related dependent variable of interest. Based on an a priori power analysis using G*Power (Faul et al., 2009), the estimated minimal necessary sample size for these studies was $N = 43$ (linear multiple regression, 3 predictors, medium effect size $f^2 = .15$, one-tailed $\alpha = .05$, power .80). We invited $N = 91$ students from an introductory psychology course at the University of Geneva to complete a questionnaire assessing their thoughts about the COVID-19 crisis for partly completing practical course-related work. Approximately 2/3 of them had completed the ACS-Fr a few months earlier. This resulted in a final sample of $N = 66$ (51 women, 15 men, average age 22 years).²

3.1.2 Freedom Restriction Questionnaire (FRQ)

We developed an 18-item questionnaire to assess disturbances caused by the 2020 COVID-19 lockdown on individuals' control on their daily life. This questionnaire focused on how people reacted to the restriction of their freedom (Cronbach's $\alpha = .83$, $M = 2.63$, $SD = 0.67$). As shown in Table S8 in the ESM, half of the items reflected negative, passive, or perseverating thoughts regarding the situation (e.g., "I have a hard time to concentrate on something else"); the other half reflected the engagement in more positive or action-related thoughts (e.g., "I am looking for new solutions to adapt my daily life"). Participants answered on 6-point scales ranging from *never* (0) to *all the time* (5). Negative items were reverse-coded so that a more positive FRQ score reflects more action-related and less ruminative thoughts.

3.1.3 Procedure

Participants had completed the ACS-Fr during a multiple questionnaire session at the beginning of their academic year. Later during the lockdown, they were invited to participate in diverse online studies. We administered the FRQ 6 weeks after the beginning of the lockdown at the end of 2 studies. It was explicitly declared that the questionnaire was independent from the first parts of those studies. Participants learned that we wanted to understand how restricted freedom due to the COVID-19 lockdown affected their daily lives and their mindsets. It was emphasized that there were no good or bad answers and that participants should answer spontaneously and honestly. It was also stressed that all following questionnaire statements concerned the time since the beginning of the lockdown.

3.1.4 Data Analysis

In this and the following two studies, we ran regression analyses with non-parametric permutation tests, which

are particularly useful when data are not normally distributed and when samples are too small to apply asymptotic theory (see Kherad-Pajouh & Renaud, 2015). Therefore, we applied the *freedman_lane* method (Freedman & Lane, 1983) for non-parametric regression analyses of the *permuco* package in R (Frossard & Renaud, 2018). This method is robust (i.e., not subject to an inflated type I error) regarding the potential impact of outliers and relatively small samples (see Anderson & Robinson, 2001). As already mentioned above, we tested our expected associations with one-tailed test, because our predictions were theory-driven and thus in a specific and clear direction in dependence on the measured dependent variables.

3.2 RESULTS AND DISCUSSION

We ran a non-parametric regression analysis with z-scores of the 3 ACS-Fr subscales as predictors and the FRQ scores as dependent variable (see ESM for descriptive statistics).

As predicted, only the Preoccupation/Disengagement subscale explained a significant part of the FRQ variance— $\beta = 0.24$ (CI = [0.03; +∞]), $t(62) = 1.92$, $p = .024$ (one-tailed), $f^2 = .06$ (CI = [.00; +∞])³—and the effect was in the expected direction. By contrast, the Hesitation/Initiative and Volatility/Persistence subscales had no significant effects, $t_s < 0.74$, $p_s > .22$. The full regression model was not significant, $F < 1.37$, $p > .25$. However, the predicted significant effect supports the expectation that only individuals who were more action-oriented according to the ACS-Fr Preoccupation/Disengagement subscale ruminated less about negative aspects of the COVID-19 lockdown. This is in line with the idea that more action-oriented individuals should engage in a more active coping mode than state-oriented persons (Kuhl, 1994a).

4. STUDY 3: PREDICTING ACTION INITIATION

This study tested the predictive power of the ACS-Fr Hesitation/Initiative subscale for action initiation. More action-oriented individuals should be more committed to their intentions (Beckmann & Kuhl, 1984) and more prone to initiate actions and thus less inclined to procrastinate (Beswick & Mann, 1994; Kazén et al., 2008; Kuhl, 1994a). We tested this idea in an ecologic setting. Specifically, we expected that university students who scored high on the Hesitation/Initiative subscale (reflecting action-orientation) should complete optional practical course-related work (i.e. obtaining credits for participating in optimal experiments) faster than those with lower scores on the Hesitation/Initiative subscale (reflecting state-orientation). That is, more action-oriented individuals should have attended more experiments in a given period of time.

4.1 MATERIALS AND METHOD

4.1.1 Participants and Design

The study design basically corresponded to that of Study 2 and thus required the same minimal sample size. However, we chose a larger sample than necessary to increase statistical power. We thus considered all the participants from a first-year psychology course at the University of Geneva for whom we had both the ACS-Fr scores and the number of optional credits. This resulted in a sample of $N = 127$ (91 women, 36 men, average age 22 years).

4.1.2 Procedure

Introductory psychology course students had to complete optional practical work to validate their grades. They could either participate in 5 of several offered experiments that were announced on a rolling basis or alternatively write a short exposé on research treated in the course. Students were free to manage when they wanted to participate in any experiments by registering online when a study was announced. All participants had responded to the ACS-Fr during a multiple questionnaire session at the beginning of the academic year. Later—after the mid-semester—11 experiments had been announced and half of the total amount of optional credits were attributed. Notably, a credit was only certified if a student attended to an experiment. Therefore, our measure comprised only participants who really participated in experiments but not those who only registered without showing up.

4.2. RESULTS AND DISCUSSION

As presented in Table S10 in the ESM, Cronbach's α s of the ACS-Fr subscales fitted those of Study 2 (see ESM for descriptive statistics). To test our directed prediction about the action-state orientation link with the number of attended experiments (i.e., initiating and progressing the optional practical work), we conducted a non-parametric regression analysis using z-scores of the 3 ACS-Fr subscales as predictors. We also included gender in the analysis as it could be a potential confound—it was correlated with the dependent variable (see Table S10), $\beta = -.20$ (CI = [-0.38; -0.01]), $t(122) = -2.13$, $p = .035$ (two-tailed), $f^2 = .04$ (CI = [.00; .14]). Female participants had more partial credits than male participants. This result is not surprising if one considers that the Hesitation/Initiative subscale is linked to procrastination—previous studies found gender effects on procrastination in academic contexts (e.g., Balkis & Duru, 2017; Mandap, 2016). However, most relevant, the effect of the Hesitation/Initiative scale was significant and in the expected direction— $\beta = .19$ (CI = [0.04; +∞]), $t(122) = 2.06$, $p = .017$ (one-tailed), $f^2 = .03$ (CI = [.00; +∞])—while the effects of the Preoccupation/Disengagement and Volatility/Persistence scales were both not significant, $t_s < 1.60$, $p_s > .11$. The full model explained 5% of the

variance (adjusted R^2), $F(4,122) = 2.55$, $p = .043$. The more action-oriented the students were according to their Hesitation/Initiative subscale scores, the faster they tended to complete the optional course work. We interpret this expected effect as reflecting the positive effect of action-orientation on action initiation and progress in an ecologically valid academic context.

5. STUDY 4: PREDICTING PERSISTENCE

This study tested the predictive power of the ACS-Fr Volatility/Persistence subscale on action execution. More action-oriented individuals should persist longer in goal-directed action than more state-oriented people (Kuhl (1994a)). Therefore, we predicted that individuals scoring high on the Volatility/Persistence subscale should continue working longer on a cognitive control task when they could decide themselves when they wanted to stop.

5.1 MATERIALS AND METHOD

5.1.1 Participants and Design

Given the identical design, the minimal sample size for this study was the same as for Studies 2 and 3. We recruited $N = 52$ participants from a first-year psychology course at the University of Geneva (44 women, 8 men, average age 23 years) who could partly validate practical course-related work with their participation. One participant was removed from all analyses due to misunderstood task instructions, leaving a final sample of $N = 51$.

5.1.2 Procedure

Participants had completed the ACS-Fr in a multiple questionnaire session at the beginning of the academic year. Later in the semester, they participated in the present study in individual sessions. The procedure was computerized (E-Prime 3.0, Psychology Software Tools, Pittsburgh, PA). After giving signed consent, participants learned that they would have the opportunity to perform 1 or 2 cognitive tasks during the next 30 min. Participants first answered 4 items of the UWIST mood scale (Matthews et al., 1990) (“Right now, I’m feeling...”) to control for possible mood influences on persistence (for reviews, see Gendolla, 2000; Martin, 2001)—which can also occur due to personality links with naturally occurring moods (e.g., Brinkmann & Gendolla, 2020). In order to prevent suspicion, the scale was presented as a standard measure taken because participants come to the laboratory in different states. Ratings of 2 positive (happy, joyful) and 2 negative affect items (downcast, sad) were made on continuous scales—ranging from 0 (*not at all*) to 100 (*very much*)—using a slider.

Next, we administered the Stroop task (Stroop, 1935). Participants learned that they could work on the upcoming task until they felt to have done enough. If they stopped before 30 min had passed, they would

work on a second task until the total performance time of 30 min would have been completed. This was done to prevent participants from stopping early on the Stroop task in order to leave the lab sooner. Participant had to press 1 out of 4 keyboard keys (h, j, k, l), corresponding to the color (blue, red, green, yellow) of words displayed on the computer screen. Stimuli were color names (blue, red, green, or yellow). Half of the trials were congruent—word and color were matched—the other half were incongruent. Participants were instructed to respond correctly and as fast as possible and to continue the task until they felt to have done enough. Trials started with a fixation cross (1000 ms) followed by a Stroop item, which remained on the screen until the participant answered within 2000 ms. Then the feedback “response entered” appeared for 1000 ms, while the message “please answer more quickly” emerged if participants did not answer within the 2000 ms. The inter-trial interval randomly varied 300–500 ms. During the response time window, the 4 colored buttons were symbolically displayed at the bottom of the computer screen—matching the keyboard buttons—to prevent confusion. Each 60 sec, the message “when you feel you have done enough, press button ‘A’ instead of making a habitual response” appeared (habitual meant pressing the colored response buttons). Participants performed 10 practice trials with correctness feedback. No such feedback was given during the main task.

After the Stroop task was stopped—either because the participant had decided to do so or because the 30 min had passed—participants rated the UWIST scale items a second time. Participants who had stopped the Stroop task before the 30 min performed the d2 mental concentration task (Brinkenamp, 1981) for the rest of the time. Here, participants had to determine if a presented stimulus was a ‘d’ with exactly 2 apostrophes which could appear above and/or under the letter. Distractors were a letter ‘d’ or a ‘p’ with more or fewer apostrophes. Trials began with a fixation cross (1000 ms), followed by a d2 item (2000 ms), and a feedback message as in the Stroop task (1000 ms); the inter-trial interval randomly varied 500–1000 ms. There were no training trials since no data of the second task were analyzed. After the task(s), participants answered biographical questions (age, sex, etc.), were debriefed, and thanked for their participation.

5.1.3 Data Analysis

Persistence was measured as the time spent on the Stroop task and the number of completed trials. The Stroop task is a cognitive conflict task in which correct responses in incongruent trials necessitate more cognitive control than in congruent trials. However, as response speed and accuracy were not of central interest in this study, their analyses are reported in the ESM.

5.2 RESULTS AND DISCUSSION

Cronbach’s α s of the ACS-Fr fitted those of our previous studies: .79, .73 and .49 for the Preoccupation/Disengagement, Hesitation/Initiative, and Volatility/Persistence subscales, respectively (see ESM for descriptive statistics). We ran two non-parametric regression analyses using z-scores of the three ACS-Fr subscales as predictors and the time spent on the Stroop task and the number of completed trials as dependent variables.

As expected, the Volatility/Persistence effects were significant for both the time spent on the task— $\beta = .46$ (CI = [0.20; + ∞]), $t(47) = 3.12$, $p = .002$, $f^2 = .21$ (CI = [.04; + ∞])—and the number of number of completed trials— $\beta = .46$ (CI = [0.21; + ∞]), $t(47) = 3.15$, $p = .001$, $f^2 = .21$ (CI = [.04; + ∞])—both one-tailed due to the directed nature of our predictions. No other effects were significant (t s < 1.64, p s > .20). The full models of both analyses were significant— $F(3,47) = 3.50$, $p = .023$, and, $F(3,47) = 3.56$, $p = .021$, respectively—and explained 13% of the variance (adjusted R^2).

As expected, action orientation assessed with the Volatility/Persistence subscale predicted longer persistence. This fits the conceptual basis of the Volatility/Persistence subscale, which refers to action execution in volitional processes—the execution and maintenance of an intended action. Action-orientation should be linked with a greater ability to maintain goal-directed actions (Kuhl, 1994a) than state-orientation. Our results confirmed this.

6. GENERAL DISCUSSION

Individual differences in self-regulation in terms of action-state orientation have important effects on whether people engage in goal pursuit and how they execute everyday goal-directed actions (see Koole et al., 2012; Kuhl, 1994a). Therefore we aimed at developing a valid French version of the ACS-90 (Kuhl, 1994b) to permit assessing action-state orientation in the French-speaking population, since validated versions of the scale only exist in German (Kuhl, 1990, 1994b) and English (Diefendorff et al., 2000). We interpret the psychometric properties of our here developed and tested French 24-item ACS-Fr version as satisfactory. Although not perfect, the scale shows convergent and discriminant internal validity that fits its theoretical basis rather well. Regarding its internal reliability, especially the 3-factorial structure of our shorter revised version has revealed satisfactory homogeneity. This basically corroborates the English and German versions of the ACS-90 (Diefendorff et al., 2000; Kuhl, 1990, 1994b). Consequently, also keeping in mind limitations of the present studies—especially the relatively small sample sizes—we regard

our ACS-Fr as a valid, economic, and thus useful tool to assess individual differences in action control. Thus, we recommend the present revised 24-item version for assessing dispositional action-state orientation in the French speaking population.

Regarding its predictive power, the revised ACS-Fr version has shown its usefulness using self-report and behavioral measures in ecological, controlled laboratory, and online study settings. In Study 2, which was conducted during the 2020 lockdown due to the COVID-19 pandemic, results showed that more action-oriented individuals were less impaired by the freedom restrictions than more state-oriented participants. Higher scores on the Preoccupation/Disengagement subscale were associated with less perseverating and negative thoughts regarding the unusual circumstances and more action planning to cope with the new situation. Study 3 revealed that more action-oriented university students, as indicated by the Hesitation/Initiative scale, were more inclined to initiate and progress in optional practical course work in their daily academic life than state-oriented individuals. This fits previous evidence that action-oriented individuals procrastinate less (e.g., Beswick & Mann, 1994) and are more committed to their intentions (Beckmann & Kuhl, 1984) than state-oriented persons. Finally, Study 4 found that action-state orientation assessed with the Volatility/Persistence scale predicted individuals' persistence in a cognitive control task—a task that calls for action control in order to respond correctly and fast. Action orientation led to longer maintenance of goal directed action than state-orientation.

On the conceptual side, our findings are concordant with the predictions of Action Control Theory (Kuhl, 1994a) and demonstrate the predictive power of the ACS-Fr—Studies 2 to 4 were conducted 2-7 months after participants had completed the ACS-Fr. The regression results of these studies emphasize the importance of using the 3 ACS-Fr subscales separately in dependence of the volitional process that is investigated—as suggested by Kuhl (1994b). Thus, our findings further suggest that the three subscales measure distinct latent variables and have discriminative predictive power.

In a larger perspective, our studies advocate for the universality of the action-state orientation construct in German, English, and French speaking cultures—although 25% of the items of our revised ACS-Fr scale differ from the two other language versions. Given that we basically found the same associations between the ACS-Fr and other self-regulation capacity measures, as well as mostly the same correlations between the three subscales as Diefendorff et al. (2000) did for the English version, we do not attribute the divergence in items to translation issues. Despite a fundamental universality of this construct, our findings may suggest some cultural differences in individuals' representation of action-state

orientation. However, we cannot draw clear conclusions about this at this time and have to leave it to future research to answer this question.

Looking at the three subscales, the relatively low internal consistency of the ACS-Fr Volatility/Persistence subscale suggests that it is a less reliable measure than the other two subscales. Although adequate—though a bit low—in Study 1, the internal consistency in our other three studies was not satisfactory according to conventional standards. Interestingly, the Volatility/Persistence scale has also earlier shown lower internal consistency than the other two ACS-90 subscales (Diefendorff et al., 2000). This could be one reason why most of the empirical research on action-state orientation has focused on effects of the Preoccupation/Disengagement and the Hesitation/Initiative subscales. Use of the Volatility/Persistence subscale has been reserved to the sports context (see Beckmann & Kazén, 1994). It is also of note that our revised Volatility/Persistence scale comprises only seven items and that factor loadings are lower than those of the two other scales—which is known to influence the internal reliability. Nevertheless, Study 4 found the theoretically predicted effect of the Volatility/Persistence scale scores on task persistence—the central aspect of the maintenance of intended actions. This parallels previous effects of the English ACS-90 version. That is, though the internal stability of the Volatility/Persistence subscale is rather low, its validity in terms of predictive power is apparently not problematic. Our results could be taken as a promising starting point for developing a better Volatility/Persistence scale with partly new items in order to strengthen its internal reliability.

We acknowledge that the present studies have limitations asking us to be cautious when interpreting our results. Analyses of convergent and discriminant validity revealed some imperfections. On the one hand, the associations between the ACS-Fr and other self-regulation capacity measures were weaker than one might expect, as reflected by relatively low R^2 s. On the other hand, the shared variance of the ACS-Fr and global personality traits was higher than Diefendorff et al. (2000) had found for the English-speaking population—particularly regarding the Hesitation/Initiative subscale. Therefore, future studies should continue to assess both constructs to further test how much unique variance action-state orientation explains beyond the Big Five personality model. Likewise, the fact that we decided to remove weakly loading items could have eliminated some facets of action-state orientation, preventing us from assessing some aspects of the original action-state orientation construct. Nonetheless, we are confident in the usefulness of our ACS-Fr. We found a rather compelling number of conceptual consistencies in terms of significant—though frequently low—associations that

corroborated the theoretical predictions and speak for the predictive power of the ACS-Fr subscales.

As a main limitation, one could argue that the samples sizes of Studies 2 and 4 were rather small, questioning the generalizability and the validity of our results. Nonetheless, it is of note that we have run permutation tests (which are also robust with relatively small samples) to control, to some extent, for sample size issues. Consequently, we believe in the validity of our results, even though we recommend that future studies should use larger samples to further enhance generalizability and to strengthen the conclusiveness of our interpretations. Finally, because our samples were not big enough to conduct structural equation model analyses, the here reported regression analyses did not take measurement and estimation errors into account. This, once again, asks us to be cautious when interpreting our results.

To conclude, we acknowledge that further studies should be run—with bigger and more heterogeneous samples—to enhance the generalizability and the

confidence we can have in our ACS-Fr. Nevertheless, we do believe that the results reported in the present four studies further support the utility of the Action Control Theory (Kuhl, 1982, 1994a) for better understanding the role of individual differences in a volitional perspective. Beyond other personality theories, the action-state orientation construct is a useful tool for researchers and practitioners investigating and assessing individual differences in the initiation, maintenance, and shielding of intentions that are important for successful goal pursuit.

APPENDIX

Items of the Three-Factor Model (items in bold correspond to the revised version) of the ACS-Fr and Factor Loadings.

Instruction: “Pour chaque question, cochez l’une des deux réponses (A ou B) qui vous convient le mieux.”

FACTOR LOADING	SUBSCALE	ITEMS
.34	Pr.	1. Quand j’ai perdu quelque chose qui a beaucoup de valeur pour moi et que je ne le trouve nulle part: A. J’ai du mal à me concentrer sur autre chose. B. Je n’y pense plus après un petit moment.
.57	He.	2. Quand je sais que je dois bientôt avoir fini quelque chose: A. Je dois me forcer pour commencer. B. Il m’est facile de le faire et de le terminer.
.27	Vo.	3. Quand j’ai appris un nouveau jeu intéressant: A. Je m’en lasse vite et fais autre chose. B. Je peux vraiment m’y consacrer un long moment.
.50	Pr.	4. Si j’ai travaillé sur un projet pendant des semaines et que finalement, tout va de travers concernant celui-ci: A. Cela me prend beaucoup de temps pour m’y adapter. B. Cela me dérange un moment puis je n’y pense plus.
.17	He.	5. Quand je n’ai rien à faire de particulier et que je m’ennuie: A. J’ai du mal à avoir assez d’énergie pour faire quoi que ce soit. B. Je trouve rapidement quelque chose à faire.
.51	Vo.	6. Quand je travaille sur quelque chose d’important pour moi: A. J’aime prendre des petites pauses en faisant d’autres choses. B. Je suis tellement plongé-e dedans que je peux travailler dessus pendant longtemps.
.08	Pr.	7. Quand je suis en compétition et que je perds tout le temps: A. J’oublie vite que j’ai perdu. B. La pensée d’avoir perdu continue à trotter dans mon esprit.

(Contd.)

FACTOR LOADING	SUBSCALE	ITEMS
.34	He.	8. Quand je me prépare à attaquer un problème difficile: A. C'est comme si j'étais face à une énorme montagne sur laquelle je ne pensais pas pouvoir grimper. B. Je cherche une manière appropriée d'approcher le problème.
.12	Vo.	9. Quand je regarde un très bon film: A. Je suis tellement plongé-e dans le film que je ne pense même pas à faire autre chose. B. Je veux souvent avoir autre chose à faire en regardant le film.
.45	Pr.	10. Si je venais de faire un nouvel achat (par exemple un appareil électronique), qu'il tombait accidentellement par terre et qu'il était irréparable: A. Je le surmonterais rapidement. B. Cela me prendrait du temps pour le surmonter.
.39	He.	11. Quand je dois résoudre un problème difficile: A. Je n'ai généralement pas de difficulté à m'y mettre. B. J'ai des difficultés à faire le vide dans ma tête et ainsi pouvoir travailler sur le problème.
.33	Vo.	12. Quand j'ai été occupé-e à faire quelque chose d'intéressant pendant longtemps (par exemple : lire un livre ou travailler sur un projet): A. Il m'arrive de me demander si ce que je suis en train de faire est vraiment utile. B. Je suis généralement tellement impliqué-e dans ce que je fais que je ne me demande jamais si c'est utile.
.40	Pr.	13. Si je dois parler à quelqu'un de quelque chose d'important et qu'à plusieurs reprises, je ne peux pas le/la trouver à la maison: A. Je ne peux pas m'empêcher d'y penser et cela même lorsque je suis en train de faire autre chose. B. Je peux facilement l'oublier jusqu'à ce que je voie la personne.
.04	He.	14. Quand je dois me décider à propos de ce que je vais faire lorsque je me trouve face à du temps libre imprévu: A. Cela me prend beaucoup de temps pour décider ce que je pourrais faire pendant ce temps libre. B. Généralement, je me décide sans avoir besoin de trop y réfléchir.
.44	Vo.	15. Quand je lis un article qui m'intéresse dans un journal: A. Je suis généralement tellement intéressé-e que je lis l'article en entier. B. Je passe souvent à un autre article avant d'avoir fini le premier.
.40	Pr.	16. Quand j'ai acheté beaucoup de choses au magasin et que je réalise, en rentrant à la maison, que j'ai trop payé – mais que je ne peux pas récupérer mon argent: A. J'ai de la peine à me concentrer sur autre chose. B. Je passe facilement à autre chose.
.62	He.	17. Quand j'ai du travail à faire à la maison: A. Il m'est souvent difficile de faire le travail. B. Je le fais généralement tout de suite.
.08	Vo.	18. Quand je suis en vacances et que je passe du bon temps: A. Après un certain temps, je ressens l'envie de faire quelque chose de complètement différent. B. Je ne pense même pas à la possibilité de faire autre chose avant la fin des vacances.

FACTOR LOADING	SUBSCALE	ITEMS
.47	Pr.	19. Quand on me dit que mon travail a été totalement insatisfaisant: A. Cela ne me dérange pas trop longtemps. B. Je me sens paralysé-e.
.44	He.	20. Quand j'ai beaucoup de choses importantes à faire et qui doivent vite être faites: A. Je ne sais souvent pas par où commencer. B. Il m'est facile de faire un plan et de m'y tenir.
.18	Vo.	21. Quand un de mes collègues soulève un sujet intéressant à discuter: A. Cela peut facilement devenir une longue conversation. B. Je me désintéresse rapidement et souhaite passer à autre chose.
.50	Pr.	22. Si je suis coincé-e dans le trafic et que je manque un important rendez-vous: A. Dans un premier temps, il m'est difficile de commencer quoi que ce soit d'autre. B. Je passe vite à autre chose.
.06	He.	23. Quand il y a deux choses que je veux vraiment faire mais que je peux seulement faire l'une des deux: A. Je commence sans tarder l'une et oublie celle que je ne pourrai pas faire. B. Il m'est difficile d'oublier la chose que je ne pourrai pas faire.
.44	Vo.	24. Quand je suis occupé-e à travailler sur un projet intéressant: A. Je dois faire des pauses régulièrement et travailler sur d'autres projets. B. Je peux travailler sur le même projet pendant longtemps.
.27	Pr.	25. Quand quelque chose est très important pour moi mais que j'ai du mal à le faire correctement: A. Je perds progressivement courage. B. Je passe à autre chose.
.68	He.	26. Quand je dois m'occuper de quelque chose d'important mais qui est désagréable: A. Je le fais et en finis avec. B. Cela peut prendre un moment jusqu'à ce que je m'y mette.
.05	Vo.	27. Lorsque dans une fête j'ai une discussion intéressante avec quelqu'un: A. Je peux lui parler pendant toute la soirée. B. Après un certain temps, je préfère passer à autre chose.
.44	Pr.	28. Quand quelque chose me déprime: A. J'ai du mal à faire quoi que ce soit d'autre. B. Il m'est facile de me distraire en faisant d'autres choses.
.49	He.	29. Quand je suis confronté-e à un gros projet qui doit être réalisé: A. Je passe souvent trop de temps à réfléchir par où je devrais commencer. B. Je n'ai aucun problème à m'y mettre.
.15	Vo.	30. Quand il s'avère que je suis bien meilleur(e) à un jeu que les autres joueurs: A. J'ai généralement envie de faire autre chose. B. J'apprécie pouvoir continuer à jouer.
.62	Pr.	31. Quand plusieurs choses vont mal pendant la même journée: A. Je ne sais généralement pas comment y faire face. B. Je continue simplement comme si rien ne s'était passé.

FACTOR LOADING	SUBSCALE	ITEMS
.38	He.	32. Quand j'ai une mission ennuyeuse: A. Je n'ai généralement aucune difficulté à la faire. B. J'ai parfois du mal à m'en occuper.
.53	Vo.	33. Quand je lis quelque chose que je trouve intéressant: A. J'ai parfois envie de mettre l'article de côté et de faire autre chose. B. Je reste assis-e et lis l'article pendant longtemps.
.47	Pr.	34. Quand j'ai mis toutes mes forces dans une tâche pour faire du bon travail et que rien ne fonctionne: A. Je n'ai pas trop de difficulté à commencer quelque chose d'autre. B. J'ai du mal à faire quoi que ce soit d'autre.
.71	He.	35. Quand je suis obligé-e de faire quelque chose d'ennuyeux et d'inintéressant: A. Je le fais et en finis avec. B. Cela peut prendre un moment jusqu'à ce que je m'y mette.
.33	Vo.	36. Quand j'essaie d'apprendre quelque chose de nouveau que je souhaite apprendre: A. Je vais continuer à essayer pendant longtemps. B. Je ressens souvent l'envie de faire une pause et de faire quelque chose d'autre pendant un certain temps.

Notes: Pr. = Preoccupation/Disengagement subscale; He. = Hesitation/Initiative subscale; Vo. = Volatility/Persistence subscale.

Factor loadings are based on the additional exploratory factor analysis using Promax rotation.

It is of note that the order of the items remains identical to that of the original English version (Kuhl, 1994).

Alternatives indicating action-orientation: For the Preoccupation/Disengagement scale: 1B; 4B; 7A; 10A; 13B; 16B; 19A; 22B; 25B; 28B; 31B; 34A. For the Hesitation/Initiative scale: 2B; 5B; 8B; 11A; 14B; 17B; 20B; 23A; 26A; 29B; 32A; 35A. For the Volatility/Persistence scale: 3B; 6B; 9A; 12B; 15A; 18B; 21A; 24B; 27A; 30B; 33B; 36A.

DATA ACCESSIBILITY STATEMENT

All data used in the analyses, the data coding and the script of the analyses are available from this link: <https://doi.org/10.26037/yareta:2rwydtfl55cdnknvtmrndawohm>.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Electronic Supplementary Material (ESM).** The ESM comprises all useful tables to interpret results of the four reported studies. It also comprises all supplementary information that one could be interested in (e.g., scales items, etc.). DOI: <https://doi.org/10.5334/spo.37.s1>

NOTES

- 1 Readers who are interested in more details about Action Control Theory and the predicted relationships between the ACS-90 and other variables are invited to consult Kuhl (1994a) and related chapters in the same book.
- 2 Participants of Studies 2–4 stem from a same cohort with more than 350 students in total.

- 3 For readers interested in standard asymptotic *p*-values, it is of note that the permuco package automatically reports these analyses, which mirrored results of permutation test. We therefore decided to not report them here.

ETHICS AND CONSENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the studies.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Author 1 contributed to the conceptualization, the development of the procedure, programmed the experiment, collected the data, analyzed the data, and wrote the paper. Author 2 contributed to the conceptualization, analyzed the data, and wrote the paper.

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