	Preregistration for Quantitative Research in Psychology Template Orange = heading		
	Not all of the following are relevant for every study; registries will make fields required or not as rel		
T=Title	**Title and title page**		
Label	**Name**		**Description**
T1	Title	To what extent is the role of language in novel task learning mediated by the expression of autism spectrum traits?	The title should be focused and descriptive, using relevant key terms to reflect what will be done in the study. Use title case (hyperlink: https://apastyle.apa.org/style-grammar-guidelines/capitalization/title-case)
T2	Contributors, Affiliations, and Persistent IDs (recommend ORCID iD)	Felice van 't Wout University of Exeter ORCID iD: https://orcid.org/0000-0003-0443-5776	Provide in separate entries the full name of each contributor, each contributor's professional affiliation, and each contributor's persistent ID. See ORCID iD for an example of persistent ID (hyperlink: https://orcid.org/). Optional: include the intended contribution of each person listed (e.g. statistical analysis, data collection; see CRediT, hyperlink: https://casrai.org/credit/)
T2	Contributors, Affiliations, and Persistent IDs (recommend ORCID iD)	Chris Jarrold University of Bristol ORCID iD: https://orcid.org/0000-0001-8662-0937	Provide in separate entries the full name of each contributor, each contributor's professional affiliation, and each contributor's persistent ID. See ORCID iD for an example of persistent ID (hyperlink: https://orcid.org/). Optional: include the intended contribution of each person listed (e.g. statistical analysis, data collection; see CRediT, hyperlink: https://casrai.org/credit/)
T3	Date of Preregistration		This is assigned by the system upon preregistration submission.
T4	Versioning information	Version 1	This is assigned by the system upon submission of original and subsequent revisions. Should be a persistent identifier, if not a DOI.
T5	Identifier		This unique identifier is assigned by the system upon submission.
T6	Estimated duration of project	4 months	Include best estimate for how long the project will take from preregistration submission to project completion.
T7	IRB Status (Institutional Review Board/Independent Ethics Committee/Ethical Review Board/Research Ethics Board)	Ethical approval will be obtained from the University of Exeter prior to the start of data collection.	If the study will include humans or animals subjects, provide a brief overview of plans for the treatment of those subjects in accordance with established ethical guidelines. If appropriate institutional approval has been obtained for the study, provide the relevant identifier here. If the study will be exempt from ethical board review, provide reasoning here.

T8	Conflict of Interest Statement	None	Identify any real or perceived conflicts of interest with this study execution. For example, any interests or activities that might be seen as influencing the research (e.g., financial interests in a test or procedure, funding by pharmaceutical companies for research).
T9	Keywords	Language; learning; skill acquisition; autism	Include terms specific to your topic, methodology, and population. Use natural language and avoid words used in the title or overly general terms. If you need help with keywords, try a keyword search using your proposed keywords in a search engine to check results.
T10	Data accessibility statement and plan	We plan to make the data available via download (usage of data for all purposes (public use file)	We plan to make the data available (drop down; yes, no) If "yes", please specify the planned data availability level (drop down): - Data access via download; usage of data for all purposes (public use file) - Data access via download; usage of data restricted to scientific purposes (scientific use file) - Data access via download; usage of data has to be agreed and defined on an individual case basis - Data access via secure data center (no download, usage/analysis only in a secure data center) - Data available upon email request by member of scientific community -Other (please specify)
T11	Optional: Code availability		We plan to make the code available (drop down; yes, no) If "yes", please specify the planned code availability level (drop down): (Use same descriptors of data in T10)

T12	Optional: Standard lab practices		Standard lab practices is a (timestamped) document, software package, or similar, which specifies standard pipelines, analytical decisions, etc. which always apply to certain types of research in a lab. Specify here and refer to at the appropriate positions in the remainder of the template. Drop Downs: We plan to make the standard lab practices available (yes, no) If "yes", please specificy the planned standard lab practices availability level: (Use same descriptors of data in T10)
A=Abstract	**Abstract (150 words)**		
Label	**Name**		**Description/Instructions: See instr**
A1	Background	Recent findings have shown that language plays a crucial role in the acquisition of novel cognitive tasks (Van 't Wout & Jarrold, 2020). Additionally, some evidence suggests that autistic individuals may not use language to	(See introduction I1)
A2	Objectives and Research questions	This study aims to investigate whether the use of language in learning novel tasks is	(See introduction I2)
A3	Participants	108 adults, who will be divided into three groups (low, medium or high) based on their Autism Spectrum Quotient score (low score = bottom 33%; medium score = middle 33%; high score = top 33%). All	(See methods M4)

A4	Study method	All participants will be required to learn six novel tasks (plus one practice round). Each task will consist of six arbitrary stimulus-response (S-R) mappings. Specifically, each task requires participants to respond to a centrally presented target image using one of six keyboard responses. Feedback will be provided on incorrect trials. During the instruction phase (when participants are presented with a visual representation of the correct S-R rules) participants will be required to perform a verbal distractor task (articulatory suppression; AS), a non-verbal distractor task (foot tapping; FT) or no distractor task, to the beat of a metronome set to 100 beats per minute. The	(See methods M10-14)

I=Introductio	**Introduction (no word limit)**		
Label	**Name**		**Description/Instructions**

I1	Theoretical background	Theories of skill acquisition (Anderson, 1982) and instruction following (Brass et al., 2017) claim that language plays a crucial role in the early stages of skill acquisition. Van 't Wout & Jarrold (2020) recently provided the first evidence consistent with this claim: Participants were required to learn a series of novel tasks (consisting of five arbitrary S-R mappings each) by trial-and-error. Performance in the early stages of learning was negatively affected by a verbal distractor task (articulatory suppression) compared to a nonverbal distractor task (foot tapping). These results clearly suggest that language	Provide a brief overview that justifies the research hypotheses.
I2	Objectives and Research question(s	The primary objective of this study was to investigate whether participants with high scores on the Autism Spectrum Quotient are less likely to use language when learning novel tasks than participants with low Autism Spectrum Quotient scores. This would result in a recuded detrimental effect of AS (compared to FT) on performance in people with high Autism Quotient Scores. A secondary objective was to investigate	Outline objectives and research questions that inform the methodology and analyses (below).

I3	Hypothesis (H1, H2, …)	H1: We predict that there will be a detrimental effect of articulatory suppression (compared to foot tapping and the no distractor task condition) on accuracy. H2: Based on previous data (Van 't Wout & Jarrold, in preparation) we predict that this detrimental effect of AS will be more pronounced with a short instruction duration (10 seconds)	Provide hypothesis for predicted results. If multiple hypotheses, uniquely number them (e.g. H1, H2a, H2b,) and refer to them the same way at other points in the registration document and in the manuscript.
I4	Exploratory research questions (if ap	E1) We might also expect the effect of ASQ score on distractor task condition to be modulated by the instruction duration. One could predict several potential outcomes: 1) We might expect participants in the low ASQ group (compared to the high ASQ group) to be worse under articulatory suppression especially when the instruction duration is short. This might be expected if non-verbal strategies are more efficient and/or effective in the high ASQ group, in which case they might benefit from such strategies more under time pressure. 2) One could also predict that high ASQ participants might benefit more from the use of superior non-	If planning exploratory analyses, provide rationale for them here.If multiple exploratory analyses, uniquely number them (E1, E2, ...) and refer to them in the same way in the registration document and in future publications.

M=Method	**Method**		
Label	**Name**		**Description/Instructions**

M1	Time point of registration	Registration prior to data collection.	Drop Down Options: Registration prior to creation of data; Registration prior to any human observation of the data; Registration prior to accessing the data; Registration prior to analysis of the data; Other (please specify; might include if T1 longitudinal data as been analyzed, but T2 has not yet been analyzed)
M2	Proposal: Use of pre-existing data (re-analysis or secondary data analysis)	No	Will pre-existing data be used in the planned study? If yes, indicate if the data were previously published and specify the source of the data (e.g., DOI or APA style reference of original publication). Specify your level of knowledge of the data (e.g., descriptive statistics from previous publications), whether or not this is relevant for the hypotheses of the present study, and how it is assured that you are unaware of results or statistical patterns in the data of relevance to the present hypotheses.
	Sampling Procedure and Data Collection		
M3	Sample size, power and precision	The estimated total of 108 participants was based on a power calculation performed on exisiting data (Van 't Wout & Jarrold, in preparation). That study found an effect size of .637 for the difference between the articulatory suppression condition and the foot tapping condition. G-Power estimates that 34 participants would be needed to detect this effect size at 95% power with an alpha level of 5%. We increased this number to 36 participants per group (to	(1) Relevant sample sizes: e.g., single groups, multiple groups, and sample sizes (or sample ranges) found at each level of multilevel data. (2) Provide power analysis (e.g. power curves) for fixed-N designs. For sequential designs, indicate your 'stopping rule' such as the points at which you intend to be viewing your data and in any way analyzing them (e.g., t-tests and correlations, but even descriptively such as with histograms).

M4	Participant recruitment, selection, an	All participants will be undergraduate students recruited via SONA, and they will receive course credit in return for their participation.	Indicate (a) methods of recruitment (e.g., subject pool advertisement, community events, crowdsourcing platforms, snowball sampling); (b) selection and inclusion/exclusion criteria (e.g., age, visual acuity, language facility); (c) details of any stratification sampling used; (d) planned participant characteristics (Gender, Race/Ethnicity, Sexual Orientation and Gender Identity, SES, education level, age, disability or health status, geographic location); (e) compensation amount and method (e.g., same payment to all, pay based on performance, lottery).
M5	How will participant drop-out be hand	Participants who do not complete the experiment will be replaced. Additionally, participants whose overall performance (RT or accuracy) is	Indicate any special treatment for participants who drop out (e.g., they are deleted from the data file entirely; there is follow-up in a manner different from the main sample) or whether participants are replaced
M6	Masking of participants and research	Masking is not necessary as this is a within-subjects design.	Indicate all forms of masking and/or allocation concealment (e.g., administrators, data collectors, raters, confederates are unaware of condition to which participants were assigned).
M7	Data cleaning and screening	Prior to data analyses, RTs greater than 5000 ms or shorter than 200 ms will be removed	Indicate all steps related to data quality control, e.g., outlier treatment, identification of missing data, checks for normality, etc.
M8	How will missing data be handled?	No missing data are anticipated, as participants who do not complete the experiment will be replaced.	Indicate (a) case deletions; (b) averaging across scale items (to handle missing items for some); (c) test of missingness (MAR, MCAR, MNAR assumptions; (d) imputation procedures (FIML vs. MI); (e) Intention to treat analysis and per protocol analysis (as appropriate)
M9	Other information (optional)		For example, training of raters/participants or anything else not yet specified.

Label	**Name**		**Description/Instructions**
	Conditions and design		
M10	Type of study and study design	This is a choice reaction time experiment (experimental study) with two within-subjects variables: distractor task type (articulatory suppression, foot tapping or no distractor task) and instruction	Indicate the type of study (e.g., experimental, observational, crossectional vs. longitudinal, single case, clinical trial) and planned study design (e.g., between vs. within subjects, factorial, repeated measures, etc.), number of factors and factor levels, etc..

M11	Randomization of participants and/or	The assignment of stimuli to conditions and the assignment of responses to stimuli will be counter balanced between subjects. The order of conditions will also be counter balanced between subjects. Trials within a task will be pseudorandomised,	If applicable, describe how participants are assigned to conditions or treatments, how stimuli are assigned to conditions, and how presentation of tests, trials, etc. is randomized. Indicate the randomization technique and whether constraints were applied (pseudo-randomization). Indicate any type of balancing across participants (e.g., assignments of responses to hands, etc.).
M12	Measured variables, manipulated va	The dependent variables are mean correct reaction time (RT) and accuracy. The independent variables are distractor task condition (articulatory suppression, foot tapping or none), instruction duration (10S or 60S) and ASQ group (low, medium or high, though note that the medium group will be excluded from analysis). Hence, this is a 2 (instruction duration) x 3 (distractor task) x 2 (high or low ASQ) mixed design. H1 would be confirmed by the presence of a main effect of distractor task condition.	This section shall be used to unambiguously clarify which variables are used to operationalize the hypotheses specified above (item I3). Please (a) list all measured variables, and (b) explicitly state the functional role of each variable (i.e., independent variable, dependent variable, covariate, mediator, moderator). It is important to (c) specify for each hypothesis how it is operationalized, i.e., which variables will be used to test the respective hypothesis and how the hyothesis will be operationally defined in terms of these variables. The description here shall be consistent with the statistical analysis plans specified under AP5 (below).
M13	Study Materials	All stimuli were black and white line drawings, selected from the International Picture Naming Project (IPNP; Bates et al., 2003). The ASQ was obtained from psychology-tools.com (Baron-Cohen et al.,	Please describe any relevant study materials. This could include, for example, stimulus materials used for experiments, questionnaires used for rating studies, training protocols for intervention studies, etc.

M14	Study Procedures	Each participants will complete 6 novel tasks (one per condition) plus one practice round (36 trials per task), after which they will complete the ASQ. In total the experiment will last 20 minutes. The experiment will be programmed in PsychoPy and run online via Pavlovia.	Please describe here any relevant information about how the study will be conducted, e.g., the number and timing of measurement time points for longitudinal research, the number of blocks or runs per session of an experiment, laboratory setting, the group size in group testing, the number of training sessions in interventional studies, questionnaire administration for online assessments, etc.
M15	Other information (optional)		

AP=Analysis	**Analysis plan (NOTE: If this varies by hypothesis, repeat analysis plan for each)**		
Label	**Name**		**Description/Instructions**
AP1	Criteria for post-data collection exclu	Participants will be excluded if their reaction times or accuracy rates are more than three standard deviations	Describe all criteria that will lead to the exclusion of a particpant's data (e.g. performance criteria, non-responding in physiological measures, incomplete data). Be as specific as possible.
AP2	Criteria for post-data collection exclusions on trial level (if applicable).	A trial will be exlcuded if it had a reaction time greater than 5000ms or lesser than 200ms (cf. Van 't Wout & Jarrold, 2020). Errors	Describe all criteria that will lead to the exclusion of a trial or item (e.g. statistical outliers, response time criteria). Be as specific as possible.
AP3	Data preprocessing	Prior to data analysis, means (for correct RT and accuracy) will be obtained per participant per condition. Participants will also be divided into three groups based on their ASQ score: There will be a Low ASQ group (bottom 33%), a	Describe all data manipulations that are performed in preparation of the main analyses, e.g. calculation of variables or scales, recoding, any data transformations, preprocessing steps for imaging or physiological data (or refer to publicly accessible standard lab procedure, cf. T12).
AP4	Reliability analysis (if applicable).	Not applicable.	Specify the type of scale reliability that will be estimated, whether it is internal consistency (e.g. Cronbachs alpha, omega), test-retest reliability, or some other form (e.g., a confirmatory factor analysis incorporating multiple factors as sources of variance). In a study involving measure development, researchers should specify criteria for removing items from measures a priori (e.g., largest factor loading magnitude, smallest drop in alpha-if-item removed).

AP5	Statistical models (provide for each h	All hypotheses will be assessed using a 2 (instruction duration) x 3 distractor task type) x 2 (ASQ group) mixed design ANOVA. H1 would be confirmed by a significant main effect of distractor task type. H2 would be confirmed by a significant two-way interaction between instruction duration and distractor task type. H3 would be confirmed by a significant two-way interaction between distractor task type and ASQ group. E1 can be assessed	Specify the statistical model (e.g. t test, ANOVA, LMM) that will be used to test each of your hypotheses. Give all necessary information about model specification (e.g., variables, interactions, planned contrasts) and follow-up analyses. Include model selection criteria (e.g., fit indices), corrections for multiple testing, and tests for statistical violations, if applicable. Wherever unclear, describe how effect sizes will be calculated (e.g., for d-values, use the control SD or the pooled SD)
AP6	Inference criteria	We will use frequentist statistics with an alpha level of 0.05.	Specify the criteria used for inferences (e.g., p values, Bayes factors, effect size measures) and the thresholds for accepting or rejecting your hypotheses. If possible, define a smallest effect size of interest. If inference criteria differ between hypotheses, specify separately for each hypothesis and respective statistical model by explicitly referring to the numbers of the hypotheses. Describe which effect size measures will be reported and how they are calculated.
AP7	Exploratory analysis (optional)	E1 can be assessed by the three-way interactions between instruction duration, distractor task type and ASQ	Describe any exploratory analyses to be conducted with your data. Include here any planned analyses that are not confirmatory in the sense of being a direct test of one of the specified hypotheses.
AP8	Other information (optional)		

O=Other	**Other information, optional (NOTE: If needed, multiple lines with other information can be i**		
Label	**Name**		**Description/Instructions**
O1	Other information (optional)		If there is any additional information that you feel needs to be included in your preregistration, please enter it here. Literature cited, disclosures of any related work such as replications or work that uses the same data, or other context that will be helpful for future readers would be appropriate here.

References

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ructions in relevant sections below