UNDER REVIEW

Argument-Based Approach to Validity:

Developing a Living Document and Incorporating Preregistration

Daria Gerasimova

Kansas University Center on Developmental Disabilities, University of Kansas

gerasimova@ku.edu

Last updated:

January 7, 2024

Abstract

I propose two practical advances to the argument-based approach to validity: developing a living document and incorporating preregistration. First, I present a potential structure for the living document that includes an up-to-date summary of the validity argument. As the validation process may span across multiple studies, the living document allows future users of the instrument to access the entire validity argument in one place. Second, I describe how preregistration can be incorporated in the argument-based approach. Specifically, I distinguish between two types of preregistration: preregistration of the argument and preregistration of validation studies. Preregistration of the argument is a single preregistration that is specified for the entire validation process. Here, the developer specifies interpretations, uses, and claims before collecting validity evidence. Preregistration of a validation study refers to preregistering a single validation study that aims to evaluate a set of claims. Here, the developer describes study components (e.g., research design, data collection, data analysis, etc.), before collecting data. Both preregistration types have the potential to reduce the risk of bias (e.g., hindsight and confirmation biases), as well as to allow others to evaluate the risk of bias and, hence, calibrate confidence, in the developer's evaluation of the validity argument.

The importance of the concept of validity generally goes undisputed. Yet, in practice, in applied research, validity often receives limited attention or even gets ignored (Barry et al., 2014; Bostic et al., 2019; Flake et al., 2017; Hussey & Hughes, 2020; Weidman et al., 2017). Although multiple definitions of validity have been proposed, the definition by AERA et al. (2014) is currently viewed as a consensus definition (e.g., Shepard, 2016). AERA et al. (2014) define validity as "the degree to which evidence and theory support the interpretations of test scores for proposed uses of tests" (p. 11). This definition emphasizes that validity is a property of score interpretations and uses rather than instruments themselves. It also highlights that validity is a matter of argument (Kane, 2006, 2013, 2015). In this paper, I adopt the consensus definition and, hence, the argument-based approach to validity.

Although the argument-based approach represents a specific way of thinking about validity and validation, its interpretations and implementations differ across researchers (see the next section for more details). Broadly, in my view, the argument-based approach consists of the following steps: (1) specifying proposed interpretations and uses of instrument scores, (2) specifying claims that need to be supported to justify the proposed interpretations and uses, (3) evaluating the claims with evidence, and (4) making a judgment about whether each of the proposed interpretations and uses is justified. Once completed, these steps constitute a validity argument. As validation is a long process, it may span across multiple validation studies, the results of which are published in multiple papers. Even when formal validation activities are completed, new evidence will continue to arrive (e.g., Kane, 2006), as new validation efforts take place (e.g., to re-evaluate evidence if substantial time has passed) and as people continue using the instrument. To accommodate this new evidence, developers need to conduct "ongoing, dynamic evaluations" (Marion, 2010, p. 266). Therefore, developing a single living document

with an up-to-date summary of all steps in the validity argument has the potential to be beneficial for future users. Thus, the first goal of this paper is to propose a structure of this document.

Next, any time researchers conduct a study (including validation studies), results are prone to researchers' biases, such as hindsight bias and confirmation bias. A tool that can be used to reduce the risk of bias, as well as to allow others to evaluate the risk of bias and, hence, calibrate confidence in research results and conclusions, is preregistration (Hardwicke & Wagenmakers, 2023). Preregistration (and open science more broadly) originated in psychology and then gained support in many other disciplines, including education [see, for example, van der Zee and Reich (2018), Cook et al. (2018), and the special issue introduced by Gehlbach and Robinson (2021)]. In general, in empirical research, preregistration refers to specifying the study design, research questions, data collection and analysis plans, and other aspects of the study as applicable and submitting this information to a public registry prior to conducting the study (e.g., Bosnjak et al., 2021). Although measurement choices are typically not a focus of preregistration, their inclusion in preregistration was also recommended (Hussey & Hughes, 2020). As I will argue below, in the context of validation research, preregistration has the potential to reduce the risk of bias, as well as allow others to assess the risk of bias, in the developer's evaluation of the validity argument. Hence, incorporating preregistration in the argument-based approach has the potential to strengthen validity arguments or, at a minimum, increase others' ability to independently evaluate the strength of the argument. Thus, the second goal of this paper is to propose how preregistration can be incorporated in the argument-based approach to validity.

Argument-Based Approach to Validity

Kane (e.g., 2006, 2013, 2015) has conducted extensive work on developing the argument-based approach to validity and to validation. AERA et al. (2014) also view validation

as a matter of argument, specifically as "a process of constructing and evaluating arguments for and against the intended interpretation of test scores and their relevance to the proposed use" (p. 11). As of today, a variety of interpretations and implementations of the argument-based approach, referencing either Kane or AERA et al. (2014) or both, have been made. As a result, although starting with stating proposed interpretations and uses is a common feature, different terminology, framing, and processes have been used for the next steps in the approach. For example, Whitney et al. (2019) framed their work in the three types of inference (scoring, generalization, and extrapolation, Kane, 2013) and developed hypotheses that support each type of inference. Whitaker et al. (2019) framed their work in the five sources of validity evidence (test content, response processes, internal structure, relations to other variables, and uses and consequences, AERA et al., 2014). Within each source, they developed claims that would support the validity of interpretations. Confrey et al. (2019) framed their work in the three components of validity (cognitive, instructional, and inferential) that were developed by Pellegrino et al. (2016) specifically for validating classroom assessments. In this framework, for each purpose of the assessment, a set of claims that span the three components are developed. Overall, in all these examples, claims (or hypotheses) are then evaluated with evidence. In contrast, Georgia Department of Education and Data Recognition Corporation (2022) did not develop claims per se; rather, they determined which validity evidence to collect and examine by crosschecking sources of validity evidence (AERA et al., 2014) with the intended purposes for the assessment. Finally, the last step of the argument-based approach involves evaluation of the overall support of using the instrument for the proposed purposes (Georgia Department of Education & Data Recognition Corporation, 2022) and plans or recommendations for future validation work (Confrey et al., 2019; Georgia Department of Education & Data Recognition

Corporation, 2022; Whitney et al., 2019). Given these differences from just a few examples, in this paper, I will describe how I interpret and implement the argument-based approach, and I acknowledge that my interpretation and implementation may differ to some extent from the intended interpretations of Kane or AERA et al. (2014) or from the interpretations of others. Notably, if the reader uses a different interpretation, the general ideas described in this paper still apply, but specific aspects of the structure of the living document may need to be adapted.

In my view, the argument-based approach starts with a specification of interpretation and use statements. The interpretation statement describes intended interpretations of instrument scores. For example, a score may indicate one's current level of the construct (e.g., psychological traits or domain-specific abilities), a performance level descriptor (e.g., what a student with a particular score knows and can do in a particular domain), future performance on a different construct (e.g., performance in college, based on college and career readiness test scores), a need for intervention (e.g., when a score is below a particular threshold), etc. Interpretation statements should also include information about the population, to which the instrument is intended to be administered. The use statement describes the purposes for which scores are intended to be used. For example, scores can be used for specific research purposes (e.g., experimental, longitudinal, cross-cultural, etc.) or specific practical purposes (e.g., referring for an intervention, informing instruction in educational settings, selection/placement in educational or job settings, etc.).

Next, the developer creates claims. Claims are statements that need to be supported in order to justify the proposed interpretations and uses. Thus, the proposed interpretations and uses guide the specification of claims. Notably, different interpretations and uses may require somewhat different claims. For example, a measure of self-efficacy for longitudinal and cross-cultural research may include claims, such as (1) items need to be representative of the construct,

(2) items need to be understood by respondents as intended, (3) the internal structure needs to be unidimensional, (4) item scores need to be internally consistent, etc. In addition, the use in longitudinal research would likely require evidence that the instrument functions in the same way across time, whereas the use in cross-cultural research would likely require evidence that scores are not biased against participants from a particular culture. However, the instrument's similar functioning across time would not be necessary for the use in cross-cultural research, and the absence of cross-cultural bias would not be necessary for the use in longitudinal research. Overall, the process of specifying claims is completed once the developer deems that all proposed interpretations and uses are fully justified by the specified claims.

Several frameworks could be used to organize claims. For example, claims can fall under five sources of validity evidence (content, response processes, internal structure, relations to other variables, and consequences of testing) and under reliability evidence (AERA et al., 2014). As another example, claims can be organized by categories of inferences, such as scoring, generalization, extrapolation, and decision (Kane, 2006). Notably, there can be zero, one, or multiple claims specified under a given category. In my view, organizing frameworks do not have to be used but can be if they help the developer specify claims. Future research may explore if the use of organizing frameworks (1) makes it easier for developers to specify claims and/or (2) enhances the quality of claims.

The next step in the argument-based approach is an evaluation of the specified claims with evidence. For instance, from the example above, the claim about construct representation can be evaluated using expert reviews, the claim about respondents' understanding of items can be evaluated via cognitive interviews, the claim about unidimensionality can be evaluated via confirmatory factor analysis, and so on. Further, the strength of evidence that one needs in order

to support a given claim may differ depending on the interpretation and use. For example, in the case of a mathematics test, one may need stronger evidence (for all or some claims) to justify uses with higher stakes (e.g., placement decisions) than uses with lower stakes (e.g., informing instruction). Notably, different claims or sets of claims can be evaluated in different validation studies. For example, expert reviews and cognitive interviews can be conducted as part of the first validation study, and dimensionality can be evaluated as part of the second validation study (on a larger sample, using the final version of the instrument from the first study). Additionally, the same claim can also be evaluated in multiple validation studies. For example, a claim about dimensionality can be initially investigated via exploratory factor analysis in one study and via confirmatory factor analysis in the following study. Once evidence for all claims is evaluated, and the degree of support for each claim is determined, the developer makes a judgment about whether each of the proposed score interpretations and uses is justified. Notably, none, one, some, or all interpretations and uses could be supported. Unsupported interpretations or uses should not be adopted by instrument users until further validation work justifies them.

Living Document

While the concept of a living document has been used in a variety of contexts, the most relevant to this paper are living systematic reviews. A living systematic review is "a systematic review that is continually updated, incorporating relevant new evidence as it becomes available" (Elliott et al., 2017, p. 24). Traditional systematic reviews can quickly become outdated; hence, practical recommendations (e.g., clinical practice guidelines in medicine), developed based on these reviews, can become inaccurate (Shojania et al., 2007). In contrast, living systematic reviews allow for developing living guidelines, i.e., for promptly updating practical recommendations based on the most up-to-date systematic evidence (Akl et al., 2017).

Validation research is similar to systematic reviews in the sense that new evidence continues to arrive and needs to be incorporated. In the case of systematic reviews, new evidence updates review results and, subsequently, guidelines. In the case of validation research, new evidence updates the validation argument, including its last step of making a judgment about whether each of the interpretations and uses is justified. As such, it seems reasonable to expect that the living nature of the validity argument may have similar benefits as living systematic reviews and living guidelines. Specifically, creating a living document that describes the current state of the validity argument enables future users of the instrument to access the most up-to-date collection of the validity evidence for this instrument and learn the most up-to-date judgement about which interpretations and uses are currently supported by the available evidence.

Preregistration

Despite good intentions, researchers can produce biased and misleading results without awareness or control due to biases, such as hindsight bias and confirmation bias. Hindsight bias refers to the people's tendency to overestimate the likelihood of the outcome occurrence after gaining knowledge about the outcome compared to before having such knowledge, while also denying the influence of the outcome knowledge on their judgement (Fischhoff, 1975/2003; Hawkins & Hastie, 1990). In other words, hindsight bias is people's belief that they "knew all along" a particular outcome. Nosek et al. (2018) describes the following common case of hindsight bias in empirical research: If a researcher makes a vague prediction, then upon seeing evidence, they can rationalize a variety of outcomes as supporting this prediction.

Confirmation bias refers to "the seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or hypothesis in hand" (Nickerson, 1998, p. 175). Nickerson (1998) emphasizes that this biased selection and use of evidence is done unwittingly,

i.e., people do not intend to be – or even realize that they are – biased. Confirmation bias can be manifested in behaviors, such as restricting one's attention to a favored hypothesis, seeking only or primarily evidence that confirms one's hypothesis, overweighting positive confirmatory evidence and underweighting negative disconfirmatory evidence, and seeing data patterns that do not exist (Nickerson, 1998). It seems reasonable to suggest that confirmation bias may operate together with hindsight bias, as one may, for example, overweight positive evidence and underweight negative evidence after seeing the evidence while believing that they knew all along that the evidence that turned out to be positive is the most important.

In validation research, considering that developers are motivated to conclude that validity is supported rather than not supported (Hussey & Hughes, 2020), the risk of bias may be substantial. Selective choice of claims before the start of the validation process may be an example of confirmation bias where the developer chooses to specify claims that are the easiest to provide satisfactory evidence for rather than all the claims that are needed to justify the proposed interpretations and uses. A claim about internal consistency may be an example of such "easy" claims. Indeed, Hussey and Hughes (2020) found that internal consistency coefficients were above the threshold they specified (.7) for 88% of examined instruments in social and personality psychology. Unsurprisingly, this source of evidence tends to be reported more often than other aspects of validity and reliability (see analyses conducted by Bostic et al., 2019, in mathematics education and by Flake et al., 2017, in social and personality psychology).

Rationalizing almost any validity evidence as supporting the claim may be an example of confirmation bias that operates together with hindsight bias. For instance, the developer can rationalize an observed stability correlation that is lower than expected as still supporting the claim while believing that a lower threshold was the most reasonable from the beginning. Indeed,

Watson (2004) found that researchers almost always labeled their stability correlations as "adequate" or "satisfactory," irrespective of the size of these correlations. Other examples are rationalizing to change the analysis to the one that achieves "adequate" results or to omit entire claims from the validity argument if the evidence was so poor that it was impossible to rationalize as adequate, all while believing that the new analysis was the most defensible to begin with or that the claim in question was not needed in the first place. It is hard to know the prevalence of these changes or omissions in validation research. However, in education research in general, almost 50% of researchers admitted to changing the statistical analysis if the initial analysis produces undesirable results (e.g., $p > .05$), and over 60% of researchers admitted to not reporting studies or variables that produces undesirable results (Makel et al., 2021).

Preregistration is particularly useful for resisting hindsight and confirmation biases (e.g., Moreau, 2019; Nosek et al., 2018; Wagenmakers et al., 2012). When preregistration is used, decisions are specified before data collection and, hence, are not dependent on data. Thus, researcher degrees of freedom – a variety of decisions that a researcher can make during the research process (Simmons et al., 2011) – are constrained, leading to bias reduction (Hardwicke & Wagenmakers, 2023). Specifically, preregistration helps reduce hindsight and confirmation biases by helping researchers remember what they believed in (e.g., which evidence they thought of as confirmatory and which as disconfirmatory) before the data had a chance to affect their beliefs. Further, preregistration also allows one to calibrate confidence in research results and conclusions (Hardwicke & Wagenmakers, 2023; Nosek et al., 2018). Specifically, preregistration enables transparent communication of decisions, made by researchers throughout the research process, as well as of the timing of these decisions. Thus, preregistration provides readers of a research report with an opportunity to distinguish between decisions that were made before data

collection, that were changed after data collection, and that were not originally planned. Knowing whether decisions were outcome-dependent allows readers to do their own evaluation of the risk of bias and, hence, calibrate their confidence in research results and conclusions.

Preregistrations can vary in the degree of comprehensiveness. Hardwicke and Wagenmakers (2023) described comprehensiveness of preregistrations as a spectrum that ranges from a 'minimal' preregistration, where a very few decisions are specified, to a 'maximal' preregistration, where decisions for all possible researcher degrees of freedom are specified. These authors argue that preregistrations anywhere on this spectrum (along with the reported deviations from the preregistration) are useful for confidence calibration, but 'maximal' preregistrations can reduce the risk of bias the most. For this reason, Hardwicke and Wagenmakers (2023) recommend prespecifying as much information as possible. A similar recommendation was also made by other researchers, e.g., Wicherts et al. (2016), McPhetres (2020), and Bosnjak et al. (2021). Wicherts et al. (2016) stated that the ideal preregistration is (1) specific, i.e., the preregistration describes in detail all steps to be taken during the research study, (2) precise, i.e., the preregistration allows for only one interpretation or implementation of each step, and (3) exhaustive, i.e., the preregistration does not allow for others steps to be taken. McPhetres (2020), in turn, stated that an effective preregistration should constrain as many researcher degrees of freedom as possible and describe in detail all methodological and analytical aspects of the study, decisions made during planning, and the interpretations and uses of the results. With that said, it should be acknowledged that sometimes developing a 'maximal' preregistration is not possible or that deviating from a preregistration is needed. As Hardwicke and Wagenmakers (2023) wrote, preregistrations should be as flexible as necessary. Although less than 'maximal' preregistrations are less capable of reducing the risk of bias, and deviations

increase the risk of bias, less than ‘maximal’ preregistrations and (transparently reported) deviations are not problems per se (Hardwicke & Wagenmakers, 2023).

While preregistrations have been most often applied in the context of confirmatory research (e.g., Nosek et al., 2018; Wagenmakers et al., 2012), their use can also be beneficial for exploratory and descriptive research. As validation work includes different types of research, highlighting these benefits is warranted. McPhetres (2020) suggested that any study, the data from which are used to make claims, descriptions, decisions, or inferences, should be preregistered to constrain researcher degrees of freedom as much as possible and, thus, limit their influence on and increase confidence in the said claims, descriptions, decisions, or inferences. Further, although in exploratory research, in contrast to confirmatory research, one might not be able to specify many aspects of the study in advance, the benefit of added transparency still applies (e.g., Haven & Van Grootel, 2019; Navarro, 2020; Piñeiro & Rosenblatt, 2016). For example, describing a starting point of a qualitative study (i.e., aspects of the study that a researcher knows or plans prior to the study even if these aspects may change later) allows the readers of the final research report to understand how the study changed between the beginning and the end (Haven et al., 2020; Piñeiro & Rosenblatt, 2016). Some researchers also note that a single preregistration, developed prior to the study, is not sufficient for exploratory research. As such, they call for using a research log that documents all changes made during the qualitative study (Piñeiro & Rosenblatt, 2016) or all computational models tested as part of the iterative model building process (Navarro, 2020).

Preregistration has also been used in validation research (e.g., Mouguiama-Daouda et al., 2022; Niemann & Hertel, 2022; Schoenegger et al., 2023). Specifically, researchers typically preregistered validation studies where they specified hypotheses or predictions (i.e., claims), as

well as described study design and data collection and data analysis plans. Notably, a preregistration of a validation study often focuses on a subset of claims. To investigate multiple subsets of claims, multiple validation studies are conducted, and preregistration is (typically) developed for each validation study. While such preregistrations are helpful for understanding developer's plans for a particular validation study, they do not provide a bigger picture of all claims, needed for a validity argument, before the validation process begins.

Goals of the Paper

This paper has two goals. First, I aim to propose a possible structure of a living document that provides potential users of an instrument with an up-to-date summary of the validity argument. In the living document, each step of the argument-based approach is described, and more information could be added as the validation process proceeds. Considering that validation may span across multiple studies, the living document has the potential to be particularly useful because it allows future users of the instrument to access the entire, up-to-date validity argument in one place. Additionally, if the effort to build a validity argument ends up not being successful and is not published (due to the publication bias), the living document still provides a record of the effort that can be helpful to others who are developing similar instruments.

Second, I aim to propose how preregistration can be incorporated in the argument-based approach to validity. Specifically, I propose two types of preregistration: preregistration of the argument and preregistration of each validation study. Preregistration of the argument is a single preregistration that is developed for the entire validation process. In this preregistration, the developer specifies interpretations, uses, and claims before collecting validity evidence. In essence, this type of preregistration constitutes the part of the living document that is developed before data collection. It differs from the commonly used preregistrations for empirical studies

and, thus, will be described in detail. Another type of preregistration – preregistration of each validation study – refers to preregistering a single validation study that aims to evaluate a particular set of claims. In this preregistration, the developer specifies research design, data collection and data analysis plans, etc. for a specific validation study, also before collecting validity evidence. This type of preregistration is similar to the commonly used preregistrations for empirical studies and, thus, will be described only briefly. Both preregistration types have the potential to reduce the risk of bias, as well as to allow others to evaluate the risk of bias and, hence, calibrate confidence, in the developer's evaluation of the validity argument.

Developing a Living Document and Incorporating Preregistration in the Argument-Based Approach to Validation

Appendix A presents a template for the potential structure of the living document (with some table cells filled with an example, which is discussed in the next section). The first four columns – *Claim, Interpretation/Use, Evidence Needed,* and *Validation Study Preregistration Link* – constitute preregistration of the validity argument. The blank templates for the Living Document and for the Preregistration of the Argument can also be accessed here: https://osf.io/tdcnq/?view_only=86ed11adf38d434c88810142fa35fcdf. These templates also include definitions of the main terms for the reader's reference.

The process of instrument development and validation starts with specifying interpretation and use statements. Next, the instrument developer specifies claims that need to be supported to justify these interpretations and uses. As each claim can be specified for more than one interpretation and/or use, the first column in the template is *Claim*, and the second column is *Interpretation/Use*. In the *Claim* column, the developer specifies claims, using as many rows as there are claims. In the *Interpretation/Use* column, the developer lists all interpretations and uses

that a given claim is intended to support. By default, all claims need to be supported by evidence in order to justify their corresponding interpretation or use. However, if the developer envisions that, for example, a provisional use could be supported by a subset of those claims, then such more nuanced conditions for making a judgment about whether the interpretation or use is justified should be described in the optional *Additional Information* section. An example of such a situation may be a provisional use of a high-stakes assessment when all but one claim are supported, with the last claim about long-term unintended consequences pending evidence from the use of the assessment. The third column is *Evidence Needed* where the developer specifies evidence that would support the claim (and, if needed, evidence that would not support the claim). Here, the description should be – using the terms of Wicherts et al. (2016) – specific, precise, and exhaustive. If providing more information about *Claim* or *Evidence Needed* is useful, then this information could be included in the optional *Additional Information* section.

In the preregistration of the argument, the first three columns (*Claim*, *Interpretation/Use*, and *Evidence Needed*) should be specified and submitted to a public registry in advance of data collection. The first two columns – *Claim* and *Interpretation/Use* – should be fully filled in at the beginning of the validation process before any validation activities are conducted. The goal of the advanced specification of these columns is to provide potential users of the instrument with a full account of what is needed for the scores, obtained via the instrument, to be ready for a particular interpretation and use. The benefit, related to the advanced nature of this specification, is the increased transparency, i.e., allowing the readers to know the starting point of the work. During the validation process, if needed, claims and interpretations/uses can be added, modified, or removed in a transparent way. The benefit, related to the completeness of this specification, occurs starting with the publication of the first validation study. As journal space is often limited

and a single validation study is often focused on a subset of claims, a bigger picture of the validity argument (i.e., all claims for all interpretations and uses) may get omitted from the publication. Having a full specification will allow the reader to understand how far along in the validation process the instrument is, i.e., how many claims have been already supported with evidence and how many are yet to be examined for a given interpretation or use to be justified. The third column – *Evidence Needed* – can be specified before the start of the validation process or added prior to each validation study. The latter option may be easier for developers, as it requires thinking through the needed evidence one study at a time. As with the first two columns, this column can also be updated later as needed in a transparent way. If the updates to any of the three columns are made after obtaining evidence, the developer must mark the changes as being made after seeing the evidence. Notably, when any updates are made, a new version of the preregistration of the argument should be created to allow readers to track the changes. All versions should be accessible to the readers.

In contrast to preregistration of the argument, preregistration of each validation study should be specified prior to the study's start of data collection. The developer may choose to use the most relevant study preregistration template, e.g., the OSF template (Bowman et al., 2020), the Psychological Research Preregistration-Quantitative template (Bosnjak et al., 2021), or the Qualitative Preregistration template (Haven et al., 2020). A typical study preregistration template includes sections about study information, research design, data collection, and data analysis. If some parts of the chosen template are not applicable to the developer's validation study, they can be skipped. A notable addition to a typical template when used for preregistration of a validation study will be the inclusion of the claims to be evaluated in the study (e.g., in the Hypotheses subsection). When some subsections in the study preregistration template are specific to a

particular claim (e.g., research questions or statistical models), the claim should be clearly referenced in the subsection. Further, *Evidence Needed* should also be included in the study preregistration and connected with the corresponding claim. Notably, *Claims* and *Evidence Needed* must be specified exactly as they are specified in the preregistration of the argument. Next, similarly to the preregistration of the argument, when updates to the study preregistration are made, a new version of the preregistration should be created to allow readers to track the changes. All versions should be accessible to the readers. Each study preregistration should also include links to the preregistration of the argument. In turn, the preregistration of the argument includes the fourth column *Validation Study Preregistration Link* that allows for linking claims with the validation study preregistrations. As preregistering a validation study is similar to preregistering a typical empirical study, I will not discuss this preregistration further.

The living document includes the information from the preregistration of the argument (*Claim, Interpretation/Use, Evidence Needed,* and *Validation Study Preregistration Link*), as well as three additional columns (*Evidence Obtained, Conclusion,* and *Date*) and one summary row at the bottom (*Overall Judgment*). Notably, the information in the first four columns in the preregistration of the argument and in the living document need to be exactly the same.

After preregistering a validation study, the developer may start collecting data. Once data needed to evaluate a given claim, are collected and analyzed, the summary of this evidence should be entered in the fifth column in the living document – *Evidence Obtained*. Links or references to detailed study reports could be included in this column, as well. Information in this column should be parallel to the information in *Evidence Needed* in the sense that all types of evidence, specified in *Evidence Needed*, need to be reported in *Evidence Obtained*. Notably, all obtained evidence, regardless of whether it is confirmatory or disconfirmatory, should be

included. The sixth column – *Conclusion* – includes the developer's judgment about whether a given claim is supported by evidence. Making this judgment involves comparing two columns – *Evidence Needed* and *Evidence Obtained*. If *Evidence Obtained* matches *Evidence Needed*, then the developer concludes that the claim is supported. In turn, if *Evidence Obtained* does not match *Evidence Needed*, then the developer concludes that the claim is not supported. There may also be situations when the developer may conclude that there is partial or mixed support for the claim. These situations may occur when there are multiple criteria for evidence. For example, in confirmatory factor analysis, the developer may specify two metrics (model fit and magnitude of loadings) but end up with only one supporting the claim. Finally, the last column – *Date* – includes information about when *Conclusion* was made or last updated. This column allows readers to know when each claim was last evaluated. *Evidence Obtained, Conclusion,* and *Date* should be filled out in the living document after the completion of each validation study.

Specifying the first three columns prior to data collection and adding the last three columns after the study completion have the potential to reduce the risk of developer's bias in the evaluation of evidence. Confirmation and hindsight biases may lead developers to change their minds after data collection about what evidence is needed to support a given claim or whether that claim is needed in the first place, while thinking that this updated view was the most reasonable from the beginning. Such rethinking may, in turn, lead to retaining claims and evidence that support the validity argument and disregarding those that do not. Nonetheless, when the developer has a reason to change *Claim*, *Interpretation/Use*, or *Evidence Needed* after seeing the evidence, making this change in a transparent way will allow the readers to calibrate their confidence in *Conclusion* and, hence, in the validity argument more broadly.

Finally, the template also includes the last row – *Overall Judgment* – that presents the developer's evaluation of whether each interpretation and each use are justified. To make this judgment, the developer needs to collectively evaluate conclusions for all claims related to a given interpretation or use. In *Overall Judgment*, the developer concludes that this interpretation or use is justified or not justified. In some situations, it may be appropriate to say that a given interpretation or use is tentatively or provisionally justified; this justification should be accompanied by a description of what such an interpretation or use means for the instrument. Notably, each time when *Evidence Obtained*, *Conclusion*, or *Overall Judgment* are added, a new version of the living document should be created. All versions should be accessible to readers.

Above the table in the template of the living document in Appendix A, the developer specifies general information about the instrument, the living document, and the preregistration of the argument. The first piece of general information is the name of the instrument and the link to the latest version of the instrument. If the instrument is not publicly available, then access instructions should be provided. If the instrument cannot be accessed, then a note about that should be made. The second piece of general information is developers' names. The third piece is the version of the living document (e.g., Version 3). The fourth piece is the link to the time-stamped preregistration of the argument that corresponds to the current version of the living document and is stored in a public registry. The fifth and sixth pieces are links to all versions of the living document and of the preregistration of the argument, respectively. These links will allow the reader to access any of the previous versions. The seventh piece is the date of the current version. Finally, the eighth piece is the update field where the developer provides a summary of how the current version differs from the previous version. Similar information also applies to the preregistration of the argument (see the template on the OSF project page).

Having multiple versions of the living document (and of the preregistration of the argument) to reflect changes resembles the notion of keeping a research log, suggested by some researchers (Navarro, 2020; Piñeiro & Rosenblatt, 2016) as an extension of preregistration. Going from one version to another, the reader will be able to trace all changes made during the validation process. Notably, versions apply not only to the situations when the information is added, removed, or modified, but also to the situations when the developer needs to start over. For example, the first validation study may have provided support for the claims about construct representation and response processes, but the second validation study may not have found support for the claim about the internal structure. Thus, the developer needs to create new items and start a new validation process. In this case, the developer should start over in a new version of the living document. The benefits of keeping previous versions of the living document include not only transparency but also information about what did not work. This information may help other developers who aim to create measures with similar score interpretations and uses.

The nature of the living document also allows for updates after the formal validation process is completed. First, the developer needs to add new evidence as it becomes available. For example, if a user of the instrument reports evidence of internal consistency based on their sample, this evidence should be added to *Evidence Obtained* for the corresponding claim in the living document; *Conclusion* and O*verall Judgment* should be re-examined in light of the new evidence and revised if needed (with a new *Date*). Second, the developer could resume the validation process if they want to develop new interpretations or uses, or if they reconsider *Claims* or *Evidence Needed* (e.g., if they deem that more claims are needed or that stronger evidence is needed). In these cases, the living document (and the preregistration of the argument as applicable) should be updated to reflect new developments in the validation process.

Notably, not only developers but also other researchers may want to resume the validation process. For example, other researchers may be interested in developing new interpretations or uses or in developing validity arguments for adapted versions of the instrument (e.g., short versions). They may also want to develop their own validity arguments for the original interpretations or uses if they disagree with the original developers about *Claims* or *Evidence Needed* or about *Conclusions* and *Overall Judgment*. In these situations, collaboration should be encouraged because it allows for keeping a single living document (and a single preregistration of the argument). Specifically, original developers and other researchers should collaborate on developing *Claims* and *Evidence Needed* for the new interpretation or use or an adapted version. The original living document should be expanded by including new information for this new interpretation or use. Further, if other researchers disagree with the original developers, a collaboration on making corrections should be considered. Notably, a collaboration may or may not result in corrections depending on whether an agreement is reached.

As subjectivity is an essential feature of validity arguments, different researchers may have different views on how *Claims* or *Evidence Needed* should be specified or what *Conclusions* and *Overall Judgment* should be made. In the situations when collaboration was not pursued due to substantial differences in the views, when collaboration was pursued but an agreement was not reached, or when the original developer was no longer available for further validation work on the instrument (e.g., due to retirement), researchers could develop a new living document (and the preregistration of the argument). In the case of different views or unresolved disagreements, different documents are actually beneficial, as they allow the readers to evaluate different validity arguments and decide if they are convinced by one or the other (or neither). To help the readers locate different validity arguments, a link to the initial living

document (and preregistration of the argument) should be included in the new living document (and preregistration of the argument), and the initial one should include a link to the new one.

Lastly, while in this paper I described the living document as a document that encompasses information from the preregistration of the argument, the living document, strictly speaking, could exist without preregistration. In other words, specifications of *Claim*, *Interpretation/Use*, and/or *Evidence Needed* could be developed retrospectively after evidence became available. The need for a retrospective specification can occur when, for example, the developer has existing evidence from their (or other's) past work and considers this evidence useful for developing a validity argument. There is no reason to exclude evidence from the validity argument just on the basis that the evidence is historic. Another example is when the developer has already completed validation work and is now looking to make all evidence accessible in one place. Providing access to the entire validity argument in a single place is beneficial by itself, even in the absence of preregistration. However, when including historical evidence and retrospectively specifying corresponding *Claim*, *Interpretation/Use*, and/or *Evidence Needed*, their retrospective nature must be transparently reported.

Simplified Example

I will use an example of a fictional instrument to illustrate how a living document can be developed and how preregistration can be incorporated. I want to emphasize that this example is a very simplified version of what a validity argument for these interpretations and uses could look like. It is not a full, and certainly not an exemplar, validity argument. It is also understood that a reasonable person may disagree with my choice of claims and evidence. My goal here is to illustrate the tool rather than to develop a defensible argument. Thus, I chose to use a fictional instrument with a simplified argument in order to (1) keep the readers' focus on the tool and not

to distract the readers from the tool to the substance of the validity argument itself and (2) be able to discuss how the tool can accommodate different ways, in which the validation process can unfold. Furthermore, I envision that real instruments will have complex validity arguments, with a large number of claims specified for each interpretation and use. Given the complexity, preregistrations of the arguments may become publications themselves.

An example of a partially completed living document is presented in Appendix A. In this example, the developer aims to design an instrument to measure mathematics self-efficacy of high school students in the USA. They propose that composite scores, computed as an average of all item scores, should be interpreted as levels of mathematics self-efficacy of high school students in the USA, with higher scores indicating higher levels of self-efficacy. They further propose two uses of the scores: (1) to determine average levels of mathematics self-efficacy of high school students in the USA and (2) to compare average levels of mathematics self-efficacy of high school students in the USA who are interested in Science, Technology, Engineering, and Mathematics (STEM) careers with those who are not interested in STEM careers.

Next, the developer specifies claims that, from their perspective, need to be supported in order to justify the proposed interpretation and uses. In total, six claims are specified about (1) respondents' understanding of the items, (2) construct representation, (3) dimensionality, (4) scoring rule justification, (5) internal consistency, and (6) bias against students who are interested in STEM careers or against those who are not interested in STEM careers (see the *Claim* column). To justify the interpretation and the first use, the first five claims need to be supported; to justify the second use, all six claims need to be supported (see the *Interpretation/Use* column). Some claims may need additional information that can be included in the *Additional Information* section. For example, the claim about respondents' understanding

of the items would be more specific and, thus, the validation process would be more transparent, if the description of intended (and unintended) understanding of each item is provided (or linked). This description can be updated as items are modified, or as new items are added.

Then, the developer specifies the evidence needed to support the claims (see the *Evidence Needed* column). The description of this evidence should be as specific, precise, and exhaustive as possible. In this example, evidence for dimensionality includes specific cut-off values for model fit indices, error correlations, and standardized item loadings, as well as statistical inferences from Chi Square tests of model fit. If needed, additional information (e.g., the response scale of item representativeness for the claim about construct representation) should be included after the table or linked. Notably, only the evidence summary should be specified; details about the validation study itself (e.g., sample size, data collection methods, or model specification details) should be included in the preregistration of the validation study rather than in the living document and the preregistration of the argument. Furthermore, in this example, there are three validation study preregistration links because the developer aims to evaluate sets of claims in three studies. In particular, the developer aims to evaluate claims about respondents' understanding of the items and about construct representation in the first study, explore dimensionality in the second study, and finally confirm the internal structure and examine the scoring rule justification, internal consistency, and bias in the third study.

For the first claim about respondents' understanding of the items, the developer might choose to work until they have items that satisfy *Evidence Needed*, and, hence, make *Conclusion* that the claim is fully supported. *Evidence Obtained* for this claim should include a summary of the retained items and, if possible, a list of the retained items (which could be presented in the *Additional Information* section). A detailed report (or a link to it), which could be also be

presented in the *Additional Information* section, may include not only the retained items but also a list of items (or prior versions of items) that did not match *Evidence Needed*, as well as problems that were identified and information about how they were addressed. These data may be highly beneficial for other developers who are designing instruments with similar interpretations and uses. For the second claim about construct representation, if *Evidence Obtain*ed does not match *Evidence Needed* and, hence, the developer makes *Conclusion* that the claim is not supported, the developer will likely proceed by revising the items. When items are revised, the claim about respondents' understanding of the items needs to be revisited (i.e., respondents' understanding of the revised items should be evaluated), and then the claim about construct representation needs to be re-evaluated. Updates to *Evidence Obtained* and to *Conclusion* need to be made in a transparent way.

For an exploratory investigation of the third claim about dimensionality, *Evidence Obtained* should include a summary of all model fit indices, statistics, and loadings, as specified in *Evidence Needed*, for the retained model. One should also include a detailed report or a link to it (in the *Additional Information* section) that describes not only the retained model, but also the tested but rejected models. If *Evidence Obtained* does not match *Evidence Needed* and, hence, one makes *Conclusion* that the claim is not supported in this validation study, the developer may choose to go back to revising items or to revise the claim instead. An example of the latter route may be changing the claim from the unidimensional structure to two-dimensional if the exploratory investigation suggested a two-dimensional model instead of a unidimensional model. It is also possible that the developer deems the discrepancy between *Evidence Needed* and *Evidence Obtained* to be small. In this case, they may choose to update *Evidence Needed* instead if deemed appropriate or, if not, may choose to make *Conclusion* that the claim is partially or

provisionally supported. In any path the developer may take, the changes they make should be transparently reported in the document to allow others to evaluate the developer's decisions. For each of the remaining claims, in a similar fashion, the developer should compare *Evidence Needed* and *Evidence Obtained*, make *Conclusion* about whether the claim is supported, and eventually make *Overall Judgment* about whether the collective consideration of *Conclusions* justifies the interpretation and each of the uses of instrument scores.

Conclusion

In this paper, I presented a structure of the living document that constitutes an up-to-date summary of all steps in the validity argument, as well as described how preregistration can be incorporated in the argument-based approach to validity. I also distinguished between two types of preregistration: preregistration of the argument and preregistration of validation studies. The living document comprises seven columns: *Claim*, *Interpretation/Use*, *Evidence Needed*, *Validation Study Preregistration Link*, *Evidence Obtained*, *Conclusion*, and *Date*, as well as a summary row: *Overall Judgment*. Preregistration of the argument comprises the first four columns: *Claim*, *Interpretation/Use*, *Evidence Needed*, and *Validation Study Preregistration Link*. Notably, while I conceptualize preregistration is an integral part of the living document, it is possible for the living document to exist without preregistration. Furthermore, there is no need to separate the living document and the preregistration of the argument into different documents stored in different places. Whether to separate them or not is a matter of capabilities of public registries. Traditionally, these registries have been limited to preregistrations rather than living documents (i.e., preregistrations that could be updated with obtained evidence and conclusions). However, this tradition may change in the future. Additionally, I want to emphasize that the presented template of the living document (and of the preregistration of the argument) is initial,

and future research is needed to evaluate its usability and usefulness. Specifically, the template should be reviewed and tested by developers who aim to apply the argument-based approach when developing and validating their instruments. Developers are also encouraged to adapt the template as needed so that the template can be collectively improved.

The next step in advancing preregistration of the argument is publishing it as a Registered Report (RR). RRs, which at Stage I include only background and methods sections, are submitted to a research journal prior to the start of the study, peer reviewed, and accepted in-principle if they pass peer review (Chambers & Tzavella, 2022). In-principle acceptance guarantees that the final (Stage II) paper will be published regardless of the results as long as the specified methods were followed. After the results are in, the final paper is peer reviewed and, if the peer review is passed, published. In application to validation research, the validity argument may become stronger (and the confirmation bias of selecting claims, evidence for which is easy provide, may be avoided) if multiple researchers have a chance to review the preregistration of the argument at Stage I and make suggestions for improvement before developers start collecting validity evidence. Furthermore, Registered Reports were found to be a promising tool for mitigating publication bias (Scheel et al., 2021). Hence, utilizing the RR format in validation research may lead to more validity arguments being published. Although RRs have not traditionally included validation work, this tradition may also change in the future.

Finally, it may seem to the reader that preregistration is a lot of work. I – and others who wrote on the topic (e.g., Nosek et al., 2019) – acknowledge that it indeed is, but I hope that the benefits I described would convince readers to start using the preregistration of the argument and that the template I provide in this paper could make the development of preregistration easier. As Nosek et al. (2019) discuss, preregistration is a skill that is new to many, and as any skill, it takes

time and practice to develop. The fear of imperfection should not be a barrier to the adoption of preregistration, as it is certainly better to have an imperfect preregistration than not to have one at all. To quote Nosek et al. (2019), "Embrace incrementalism" (p. 817), and with experience, developing preregistrations will become easier, and their quality will improve. The same can be applied to the skills of developing a living document, as well.

In sum, developing a living document and incorporating preregistration provide practical advances to the argument-based approach to validity. The living document allows future users of the instrument to access the entire validity argument in one place. In turn, preregistration has the potential to reduce the risk of the developer's bias that may occur during the validation process. Or, at a minimum, it has the potential to increase the transparency of the validation process, allowing readers to calibrate their confidence in the validity argument.

Acknowledgements

I am grateful to Tyler Hicks, Erin Krupa, Ian Tingen, John Sakaluk, and three anonymous reviewers for their helpful feedback on the earlier versions of this paper.

References

AERA, APA, & NCME. (2014). *Standards for educational and psychological testing*. American Educational Research Association.

Akl, E. A., Meerpohl, J. J., Elliott, J., Kahale, L. A., Schünemann, H. J., Agoritsas, T., Hilton, J., Perron, C., Akl, E., Hodder, R., Pestridge, C., Albrecht, L., Horsley, T., Platt, J., Armstrong, R., Nguyen, P. H., Plovnick, R., Arno, A., Ivers, N., … Pearson, L. (2017).

Living systematic reviews: 4. Living guideline recommendations. *Journal of Clinical Epidemiology*, *91*, 47–53. https://doi.org/10.1016/j.jclinepi.2017.08.009

Barry, A. E., Chaney, B., Piazza-Gardner, A. K., & Chavarria, E. A. (2014). Validity and reliability reporting practices in the field of health education and behavior: A review of seven journals. *Health Education & Behavior*, *41*(1), 12–18. https://doi.org/10.1177/1090198113483139

Bosnjak, M., Fiebach, C. J., Mellor, D., Mueller, S., O'Connor, D. B., Oswald, F. L., & Sokol-Chang, R. I. (2021). A template for preregistration of quantitative research in psychology: Report of the joint psychological societies preregistration task force. *American Psychologist*, *Advance online publication*. https://doi.org/10.1037/amp0000879

Bostic, J. D., Krupa, E. E., Carney, M. B., & Shih, J. C. (2019). Reflecting on the past and looking ahead at opportunities in quantitative measurement of K-12 students' content knowledge. In J. D. Bostic, E. E. Krupa, & J. C. Shih (Eds.), *Quantitative measures of mathematical knowledge: Researching instruments and perspectives* (pp. 205–229). Routledge.

Bowman, S., DeHaven, A. C., Errington, T., Hardwicke, T. E., Mellor, D. T., Nosek, B. A., & Soderberg, C. K. (2020). *OSF Prereg Template*. MetaArXiv. https://doi.org/10.31222/osf.io/epgjd

Chambers, C. D., & Tzavella, L. (2022). The past, present and future of Registered Reports. *Nature Human Behaviour*, *6*(1), Article 1. https://doi.org/10.1038/s41562-021-01193-7

Confrey, J., Toutkoushian, E., & Shah, M. (2019). A validation argument from soup to nuts: Assessing progress on learning trajectories for middle-school mathematics. *Applied*

Measurement in Education, *32*(1), 23–42. https://doi.org/10.1080/08957347.2018.1544135

Cook, B. G., Lloyd, J. W., Mellor, D., Nosek, B. A., & Therrien, W. J. (2018). Promoting open science to increase the trustworthiness of evidence in special education. *Exceptional Children*, *85*(1), 104–118. https://doi.org/10.1177/0014402918793138

Elliott, J. H., Synnot, A., Turner, T., Simmonds, M., Akl, E. A., McDonald, S., Salanti, G., Meerpohl, J., MacLehose, H., Hilton, J., Tovey, D., Shemilt, I., Thomas, J., Agoritsas, T., Hilton, J., Perron, C., Akl, E., Hodder, R., Pestridge, C., … Pearson, L. (2017). Living systematic review: 1. Introduction—the why, what, when, and how. *Journal of Clinical Epidemiology*, *91*, 23–30. https://doi.org/10.1016/j.jclinepi.2017.08.010

Fischhoff, B. (2003). Hindsight ≠ foresight: The effect of outcome knowledge on judgment under uncertainty. *BMJ Quality & Safety*, *12*(4), 304–311. https://doi.org/10.1136/qhc.12.4.304 (Reprinted from Journal of Experimental Psychology: Human Perception and Performance, 1, 288–299, 1975)

Flake, J. K., Pek, J., & Hehman, E. (2017). Construct validation in social and personality research: Current practice and recommendations. *Social Psychological and Personality Science*, *8*(4), 370–378. https://doi.org/10.1177/1948550617693063

Gehlbach, H., & Robinson, C. D. (2021). From old school to open science: The implications of new research norms for educational psychology and beyond. *Educational Psychologist*, *0*(0), 1–11. https://doi.org/10.1080/00461520.2021.1898961

Georgia Department of Education, & Data Recognition Corporation. (2022). *Georgia Milestones Assessment System: 2022 operational technical report*. https://www.gadoe.org/Curriculum-Instruction-and-

Assessment/Assessment/Documents/Milestones/Technical_Documents/GA_Milestones_2021-2022_Technical_Report.pdf

Hardwicke, T. E., & Wagenmakers, E.-J. (2023). Reducing bias, increasing transparency and calibrating confidence with preregistration. *Nature Human Behaviour*, *7*(1), Article 1. https://doi.org/10.1038/s41562-022-01497-2

Haven, T. L., Errington, T. M., Gleditsch, K. S., van Grootel, L., Jacobs, A. M., Kern, F. G., Piñeiro, R., Rosenblatt, F., & Mokkink, L. B. (2020). Preregistering qualitative research: A Delphi study. *International Journal of Qualitative Methods*, *19*, 1–13. https://doi.org/10.1177/1609406920976417

Haven, T. L., & Van Grootel, Dr. L. (2019). Preregistering qualitative research. *Accountability in Research*, *26*(3), 229–244. https://doi.org/10.1080/08989621.2019.1580147

Hawkins, S. A., & Hastie, R. (1990). Hindsight: Biased judgments of past events after the outcomes are known. *Psychological Bulletin*, *107*(3), 311–327.

Hussey, I., & Hughes, S. (2020). Hidden invalidity among 15 commonly used measures in social and personality psychology. *Advances in Methods and Practices in Psychological Science*, *3*(2), 166–184. https://doi.org/10.1177/2515245919882903

Kane, M. T. (2006). Validation. In R. Brennan (Ed.), *Educational measurement* (4th ed., pp. 17–64). American Council on Education and Praeger.

Kane, M. T. (2013). Validating the interpretations and uses of test scores. *Journal of Educational Measurement*, *50*(1), 1–73. https://doi.org/10.1111/jedm.12000

Kane, M. T. (2015). Validation strategies: Delineating and validating proposed interpretations and uses of test scores. In S. Lane, M. R. Raymond, & T. M. Haladyna (Eds.), *Handbook of test development* (pp. 80–96). Routledge.

Makel, M. C., Hodges, J., Cook, B. G., & Plucker, J. A. (2021). Both Questionable and Open Research Practices Are Prevalent in Education Research. *Educational Researcher*, *50*(8), 493–504. https://doi.org/10.3102/0013189X211001356

Marion, S. (2010). Constructing a validity argument for alternate assessments based on modified achievement standards. In M. Perie (Ed.), *Alternate assessments based on modified achievement standards* (pp. 247–268). Brooks Publishing.

McPhetres, J. (2020). *What should a preregistration contain?* PsyArXiv. https://doi.org/10.31234/osf.io/cj5mh

Moreau, D. (2019). Preregistration in the context of expertise research: Benefits, challenges, and recommendations. *Journal of Expertise*, *2*(4), 210–216.

Mouguiama-Daouda, C., Blanchard, M. A., Coussement, C., & Heeren, A. (2022). On the measurement of climate change anxiety: French validation of the Climate Anxiety Scale. *Psychologica Belgica*, *62*(1), 123–135. https://doi.org/10.5334/pb.1137

Navarro, D. (2020). *Paths in strange spaces: A comment on preregistration*. PsyArXiv. https://doi.org/10.31234/osf.io/wxn58

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175–220.

Niemann, L., & Hertel, G. (2022). Perceived forcedness and perils of migration: Development and validation of a questionnaire for residents in receiving countries. *International Journal of Intercultural Relations*, *89*, 1–18. https://doi.org/10.1016/j.ijintrel.2022.05.002

Nosek, B. A., Beck, E. D., Campbell, L., Flake, J. K., Hardwicke, T. E., Mellor, D. T., van ’t Veer, A. E., & Vazire, S. (2019). Preregistration is hard, and worthwhile. *Trends in Cognitive Sciences*, *23*(10), 815–818. https://doi.org/10.1016/j.tics.2019.07.009

Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). The preregistration revolution. *Proceedings of the National Academy of Sciences*, *115*(11), 2600–2606.

Pellegrino, J. W., DiBello, L. V., & Goldman, S. R. (2016). A framework for conceptualizing and evaluating the validity of instructionally relevant assessments. *Educational Psychologist*, *51*(1), 59–81. https://doi.org/10.1080/00461520.2016.1145550

Piñeiro, R., & Rosenblatt, F. (2016). Pre-analysis plans for qualitative research. *Revista de Ciencia Política*, *36*(3), 785–796.

Scheel, A. M., Schijen, M. R. M. J., & Lakens, D. (2021). An excess of positive results: Comparing the standard psychology literature with registered reports. *Advances in Methods and Practices in Psychological Science*, *4*(2), 1–12. https://doi.org/10.1177/25152459211007467

Schoenegger, P., Maier, M., & Sousa Bastos, R. V. (2023). Introduction and validation of the Short Antinatalism Scale (S-ANS). *Psychological Test Adaptation and Development*, *4*(1), 28–40. https://doi.org/10.1027/2698-1866/a000036

Shepard, L. A. (2016). Evaluating test validity: Reprise and progress. *Assessment in Education: Principles, Policy & Practice*, *23*(2), 268–280. https://doi.org/10.1080/0969594X.2016.1141168

Shojania, K. G., Sampson, M., Ansari, M. T., Ji, J., Doucette, S., & Moher, D. (2007). How quickly do systematic reviews go out of date? A survival analysis. *Annals of Internal Medicine*, *147*(4), 224–233. https://doi.org/10.7326/0003-4819-147-4-200708210-00179

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, *22*(11), 1359–1366. https://doi.org/10.1177/0956797611417632

van der Zee, T., & Reich, J. (2018). Open education science. *AERA Open*, *4*(3), 2332858418787466. https://doi.org/10.1177/2332858418787466

Wagenmakers, E.-J., Wetzels, R., Borsboom, D., van der Maas, H. L. J., & Kievit, R. A. (2012). An agenda for purely confirmatory research. *Perspectives on Psychological Science*, *7*(6), 632–638. https://doi.org/10.1177/1745691612463078

Watson, D. (2004). Stability versus change, dependability versus error: Issues in the assessment of personality over time. *Journal of Research in Personality*, *38*(4), 319–350. https://doi.org/10.1016/j.jrp.2004.03.001

Weidman, A. C., Steckler, C. M., & Tracy, J. L. (2017). The jingle and jangle of emotion assessment: Imprecise measurement, casual scale usage, and conceptual fuzziness in emotion research. *Emotion*, *17*(2), 267–295. https://doi.org/10.1037/emo0000226

Whitaker, D., Unfried, A., & Bond, M. (2019). Design and validation arguments for the student survey of motivational attitudes toward statistics (S-SOMAS) instrument. In J. D. Bostic, E. E. Krupa, & J. C. Shih (Eds.), *Assessment in Mathematics Education Contexts* (pp. 120–146). Routledge.

Whitney, B. M., Cheng, Y., Brodersen, A. S., & Hong, M. R. (2019). The scale of student engagement in statistics: Development and initial validation. *Journal of Psychoeducational Assessment*, *37*(5), 553–565. https://doi.org/10.1177/0734282918769983

Wicherts, J. M., Veldkamp, C. L. S., Augusteijn, H. E. M., Bakker, M., van Aert, R. C. M., & van Assen, M. A. L. M. (2016). Degrees of freedom in planning, running, analyzing, and reporting psychological studies: A checklist to avoid p-hacking. *Frontiers in Psychology*, *7*, 1–12. https://doi.org/10.3389/fpsyg.2016.01832

Appendix A

Simplified Example of the Living Document (partially completed)

Instrument Name and Link to the Latest Version of the Instrument: High School Mathematics Self-Efficacy Measure, [Link]
Developers: [Names]
Version of the Living Document: 1
Link to the Preregistration of the Argument: [Link]
Link to All Versions of the Living Document: [Link]
Link to All Versions of the Preregistration of the Argument: [Link]
Date: January 12, 2022
Update: n/a

Claim	Interpretation / Use	Evidence Needed	Validation Study Preregistration Link	Evidence Obtained	Conclusion	Date
1. Items need to be understood by respondents as intended.*	Interpretation #1, Uses #1 & #2	For each item, when a problem of the lack of understanding or unintended understanding is identified during cognitive interviews, the item is revised to resolve the problem. Each item needs to not show problems (i.e., be understood as intended) for all subsequent interviews (at least 5).	Link 1			
2. Items need to be representative of the construct.	Interpretation #1, Uses #1 & #2	Expert ratings of the representativeness of all items, on average, need to be at least 3 on the 1-4 scale.**	Link 1			
3. The internal structure needs to be unidimensional.	Interpretation #1, Uses #1 & #2	Exploratory factor analysis models with 1 and 2 factors need to be tested. The 1-factor model needs to have acceptable absolute fit (RMSEA < 0.06, SRMR < 0.08, CFI > 0.95, TLI > 0.95; also, Chi Square needs to be statistically non-significant, $p < .05$, OR expected error correlations from the modification indices output need to be < 0.2). Standardized item loadings need to be at least 0.5. Further, the 1-factor model needs to not fit significantly worse than the 2-factor model, as determined by Chi Square difference tests ($p > .05$).	Link 2			
		A confirmatory factor analysis model with 1 factor needs to be tested. The 1-factor model needs to have acceptable absolute fit	Link 3			

Claim	Interpreta-tion / Use	Evidence Needed	Validation Study Preregistration Link	Evidence Obtained	Con-clusion	Date
		(RMSEA < 0.06, SRMR < 0.08, CFI > 0.95, TLI > 0.95; also, Chi Square needs to be statistically non-significant, p < .05, OR expected error correlations from the modification indices output need to be < 0.2). Standardized item loadings need to be at least 0.5.				
4. The scoring rule for composite scores (averaging item scores) needs to be justified.	Interpreta-tion #1, Uses #1 & #2	The parallel confirmatory factor analysis model with 1 factor needs to be tested (i.e., all loadings need to be constrained to be equal, and all error variances need to be constrained to be equal). The parallel model needs to not fit significantly worse than the congeneric 1-factor model (i.e., the model without equality constraints on loadings and error variances), as determined by a Chi Square difference test (p > .05).	Link 3			
5. Item scores need to be internally consistent.	Interpreta-tion #1, Uses #1 & #2	Cronbach's alpha needs to be > 0.7.	Link 3			
6. Scores need to not be biased against students who are interested in STEM careers or against those who are not interested in STEM careers.	Use #2	Scalar measurement invariance needs to be tested via multi-group confirmatory factor analysis using the parallel model with 1 factor (i.e., all loadings need to be constrained to be equal across and within groups, and intercepts need to be constrained to be equal across but not within groups). The scalar model needs to not fit significantly worse than the configural model that is based on the parallel model with 1 factor (i.e., the model without cross-group equality constraints on loadings and intercepts), as determined by a Chi Square difference test (p > .05).	Link 3			
Overall judgment:						

Note: Interpretation #1: "Composite scores on the instrument, computed as an average of all item scores, should be interpreted as levels of mathematics self-efficacy of high school students in the USA, with higher scores indicating higher levels of self-efficacy."; Use #1: "To determine average levels of mathematics self-efficacy of high school students in the USA"; Use #2: "to compare average levels of mathematics self-efficacy of high school students in the USA who are interested in STEM careers with those who are not interested in STEM careers".

Additional Information: [The following information may be included]
* A description of intended (and potentially unintended) understanding. ** The scale, on which representativeness is measured.