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Validation of the Coffee Knowledge Test for Assessing Expertise in Coffee

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ABSTRACT

Perception and appreciation of food and beverages are shaped by an individual's knowledge and expertise. While wine expertise has been widely studied, less is known about how coffee expertise influences sensory perception. This study aimed to validate the Coffee Knowledge Test developed by Croijmans and Majid (2016) as a tool for assessing coffee expertise. We adapted the test and examined its reliability using data from 267 participants, comparing novice consumers and coffee professionals. Internal consistency was evaluated using item variability, correlation analysis, and Cronbach's α , while external validity was assessed by comparing scores between the two groups. The test showed sufficient item variability, appropriate correlations, and strong internal consistency. Importantly, coffee professionals scored significantly higher than novices. These results support the Coffee Knowledge Test as a valid and reliable instrument for measuring coffee-related knowledge and expertise.

1 | Introduction

Coffee is one of the most popular beverages in the world—2.25 billion cups were consumed daily across the globe in 2024 (Allen 2024). With such widespread consumption, consumers of coffee vary in their knowledge about coffee. While many consumers may not care much about the origin of their coffee, or what specific type it is, a large share of the market is also taken up by brands that cater to more interested consumers keen to try something new occasionally. These brands inform the consumer about where the coffee is made, its production process, and sustainability factors. These consumers can also enroll in education programs, similar to wine appreciation, and coffee companies might even offer their customers training and courses to better understand their favorite beverage. With more exposure and education, these

consumers become more experienced, which can in turn impact their perception (Hayakawa et al. 2010). What is perceived as good coffee by regular consumers is not necessarily explained by what is understood as high quality by the coffee industry, or preferred by more seasoned enjoyers (Giacalone et al. 2016). Understanding the role expertise plays in differences between coffee professionals and consumers can provide valuable insights into developing strategies that support sustainable production and meet evolving consumer demands for the coffee industry.

The level of knowledge, or expertise, about a food or beverage, significantly shapes our perception and cognition of it (Dacremont et al. 2000; Elgaard et al. 2019; Hayakawa et al. 2010; Parr 2019; Rumiaty and Foroni 2016), as well as our ability to appreciate and discriminate such products (Bitnes et al. 2007; Hughson and

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Summary

- The Coffee Knowledge Test provides researchers and professionals in the coffee industry with a reliable instrument to assess individuals' domain-specific level of coffee expertise.
- In sensory research, it allows for the investigation of, and control for, participant coffee expertise levels when evaluating flavor perception, aroma identification, and hedonic responses, as the domain-specific expertise has implications for perception.
- Further, by being able to distinguish between experts and novice consumers, companies can refine product development and enhance customer experiences by better understanding their consumers' perceptions.

Boakes 2001). Expertise is often divided into two types, namely epistemic expertise and performative expertise (Weinstein 1993). Epistemic expertise denotes specialized knowledge, where one can be an expert in a domain, meaning having knowledge about the topic. Performative expertise refers to a demonstrable skill, and thus a performative expert is an expert at some skill.

Topic expertise influences how sensory stimuli are perceived (Arvisenet et al. 2016; de-la-Fuente-Blanco et al. 2017; Honorio et al. 2019; Wang et al. 2021). Research has shown that expertise in a specific domain, such as wine, reduces the effects of cross-modal interactions (de-la-Fuente-Blanco et al. 2017). This may be the result of the modification of evaluation strategies by experts compared to non-experts (Arvisenet et al. 2016). Wine experts have further been found to remember wines better than non-experts (Croijmans et al. 2021), and report more vivid imagery for the smell and flavor of wines than novices (Croijmans et al. 2020). Additionally, sensory training has been demonstrated to enhance sensory acuity, suggesting another pathway through which expertise exerts its influence (Wang et al. 2021). (Spence 2019) proposed that perceptual learning might also be a key component of expertise, and in the same review, called for more research into the effects of expertise on perception and perceptual learning. How expertise shapes these cognitive and perceptual factors may also explain different choices observed in consumers with differing experiences (Wirtz and Mattila 2003). For that reason, being able to quantify the level of flavor expertise is interesting both from a fundamental mechanistic perspective, as well as from an application-focused perspective.

Most research on beverage flavor expertise comes from studies with wine experts, with only a few studies examining the effects of expertise in other domains, such as beer. Very few studies have focused on coffee. One reason there may have been a disproportionate focus on wine expertise could be due to the availability of wine experts as a result of the institutionalized nature of education on wine. This makes it relatively easy to track the level of wine expertise someone has, as education level can be used to coarsely quantify the amount of experience. In fact, several tools outside these institutions have also been developed to establish wine expertise among individuals, including the Wine Trivia Test (Frøst and Noble 2002), the Wine Knowledge Test (Croijmans and Majid 2016; Hughson

and Boakes 2001; Melcher and Schooler 1996) and the Subjective Wine Knowledge Questionnaire (Johnson and Bastian 2007; Klein Hazebroek and Croijmans 2023).

In contrast, although expertise in coffee is somewhat institutionalized in the shape of standardized curricula (e.g., the Q-grader program, Specialty Coffee Association education programs), these programs are tailored toward coffee professionals, who are already at the higher end of the expertise spectrum. To quantify the level of experience in non-professional coffee consumers, other tools are necessary. In an earlier study, Croijmans and Majid (2016) developed the Coffee Knowledge Test (CKT) to assess coffee expertise in their study of how flavor expertise shapes language for wine and coffee. Croijmans and Majid found that CKT scores were significantly higher among self-reported coffee experts than non-experts, giving a first indication of the usefulness of the CKT. However, the validity and consistency of the CKT were not formally evaluated.

In this study, we aim to validate for the first time the CKT as a reliable tool for assessing coffee expertise. We begin by describing how the original CKT was developed, and how this version was re-evaluated and revised to improve content validity. Next, we measure internal and external validity as measures of coffee expertise.

2 | Methods

2.1 | Coffee Knowledge Test

The Coffee Knowledge Test used in this study was an adapted version of the Coffee Knowledge Test developed by Croijmans and Majid (2016). The main outcome of the test is an Overall Coffee Knowledge score, which is a composite score of all items. The original test was developed in analogy to the Wine Knowledge Test (Hughson and Boakes 2001; Melcher and Schooler 1996), which is composed of eight 2-option questions about grape varieties, seven questions on vinification techniques and specific wine types, and two questions about the frequency of consumption and level of wine literacy.

In the Coffee Knowledge Test, two questions (questions three and five) were changed from the version developed originally by Croijmans and Majid (2016) based on feedback from the authors of the original test. Thus, two new questions were included instead. Both the original and the modified version of the CKT contain eight 2-option questions about the origin of specific coffee varieties, seven questions about the history and production of coffee, and two questions regarding coffee literacy level and frequency of consumption. The initial version of the original CKT was evaluated by two SCA-qualified coffee experts to check the phrasing and factual correctness of the questions and answers. The items of the test and their impact on the final score can be found in Table 1.

2.2 | Participants and Procedure

Data was collected at three different locations. All participants were coffee-drinking individuals. The characteristics of the

TABLE 1 | Items and answer options included in the modified Coffee Knowledge Test. Question 1 is a compound question consisting of 8 items, which summed add to 1 point for the whole question.

Questions ^a		Possible answers (points) ^b
Q1: From which countries do these coffee varieties originate?		
Blue Mountain		Jamaica (0.125); Brazil (0)
Kona		Kenya (0); Hawaii (0.125)
Sidamo		Indonesia (0); Ethiopia (0.125)
Antigua		Guatemala (0.125); Colombia (0)
Yirgacheffe		Brazil (0.125); Ethiopia (0)
Java		Vietnam (0); Indonesia (0.125)
Bourbon Santos		Brazil (0.125); Colombia (0)
Tarrazu		Costa Rica (0.125); Puerto Rico (0)
Q2: Which country does coffee most likely originate from?		Turkey (0); Java (0); Colombia (0); Ethiopia (1); India (0)
Q3: What is the primary sensory trait of Geisha (Gesha) coffee?		Fruity notes (1); High sweetness (0); Strong body (0); Chocolate notes (0); Nutty notes (0)
Q4: What is “peaberry”?		A classification for a small coffee bean; A specific coffee variety from India (0); A term for one instead of two coffee beans per coffee berry (1); A tool that is used for roasting coffee (0); A coffee plant disease that prevents the coffee bean from ripening, but makes it stay green, making them look like peas (0)
Q5: How is the Central American quality designation <i>Superior</i> defined?		The coffee achieved a cupping score above 90 (0); The bean size is larger than screen size 16 (6.5 mm) (1); The coffee is hand-picked (0); The coffee bean variety is Arabica (<i>Coffea Arabica</i>) (0); The coffee is grown at an altitude above 1400 m (0)
Q6: “Coffee rust” can best be defined as:		A specific aroma in the coffee caused by the mold <i>Hemileia vastatrix</i> during fermentation (0); A coffee plant disease (<i>Hemileia vastatrix</i>) that potentially can destroy the plant (1); A common metal taste caused by rust in the coffee maker (0); The ideal color of a coffee bean after roasting (0); A word the professional baristas use to describe the remains in the cup after drinking (0)
Q7: What is the difference between the “wet” and “dry” method to process the coffee berries into green coffee?		The wet method requires complex machines, and the dry method is simpler (0); In the wet method, the outer layer of the coffee berry is removed before drying (0); in the dry method, the coffee beans are dried in the sun (0); In the wet method, there is a fermentation phase in which some of the outer layer are removed (0); All above answers are correct (1)
Q8: What is the correct way to age coffee with the intention to increasing quality		By grinding the roasted coffee and storing it in an open can for a few weeks to allow the coffee to breathe (0); By storing the coffee beans in the freezer (0); By allowing the coffee berries to dry for a longer period (0); By storing the unroasted coffee for a few months to a year under controlled conditions (1); By only using coffee berries from very old coffee bushes (0)
Q9: How much coffee do you drink?		More than 4 cups per day (3); 2–4 cups per day (2); 1–2 cups per day (1); Less than 1 cup per day (0)
Q10: How much have you read about coffee?		More than 4 books and/or articles (3); 1–4 books and/or articles (2); Less than 1 book (1); Nothing (0)

^aThe questionnaire has been revised in this manuscript to improve the English grammar.

^bCorrect answers in bold; I do not know was also an answer option for questions 1–8.

TABLE 2 | Characteristics of participants in the novice consumers and expert professionals groups, respectively.

	Novice consumers	Expert professionals
<i>n</i>	229	38
Mean age (range)	30.0 (18–70)	34.5 (23–55)
Number of women (%) ^a	112 (46.9)	21 (47.7)
Coffee experts	No	Yes

^aAll non-women identified as men.

coffee professional and novice consumer participants, respectively, can be found in Table 2.

Novice consumer data was collected at Aarhus University, Aarhus, Denmark on September 27, 2019, and in Copenhagen, Denmark on July 20, 2019. At Aarhus University, students and staff were recruited in student eating areas. In Copenhagen, data collection was conducted at a coffee event where participants were interested in coffee but did not have coffee expertise.

Coffee professional data was collected at a coffee event with an international audience held by the Specialty Coffee Association (SCA) in Zürich, Switzerland on February 10 and 11, 2020. Participants were members of the Specialty Coffee Association and were thus all considered coffee professionals. Participants were mainly European (82%). However, participants also came from other parts of the world. Only two participants were from countries that produce coffee.

All data were collected using the software Compusense (Compusense Inc., Guelph, ON, Canada). The questionnaire was administered in English to all participants.

2.3 | Ethics Statement

Danish law only requires research ethical review in studies in health science (Bekendtgørelse Af Lov Om Videnskabetisk Behandling Af Sundhedsvidenskabelige Forskningsprojekter Og Sundhedsdatavidenskabelige Forskningsprojekter 2020), and questionnaire studies are exempted from research ethical review (Hvilke projekter skal anmeldes? 2025), no institutional ethics approval was sought. Participating in this study did not inflict risks beyond those encountered in normal everyday life, and participants provided their informed consent before participating.

2.4 | Statistical Analysis

The analysis of the validity of the modified CKT was conducted using descriptive statistics, correlation analysis, Cronbach's α , and factor analysis (Dima 2018). All data analyses were performed using R (R Core Team 2024) and RStudio (RStudio Team 2015). Visualizations and data formatting were executed using the Tidyverse package collection (Wickham et al. 2019).

2.4.1 | Internal Validity

To evaluate the internal validity of the modified CKT, item variation was assessed by calculating the frequency and percentage of correct responses for each item across all participants. A heatmap was generated to visualize the correlation between the 10 items. The correlation coefficients for correct versus incorrect answers were calculated using pairwise complete observations. The heatmap was created using the ggcorrplot package (Kassambara 2023).

The reliability of the item set was evaluated using Cronbach's α . The standardized Cronbach's α is used to investigate the overall reliability of the construct. To test the contribution of each item to the construct, a leave-one-out Cronbach's α was calculated for each item. Cronbach's α was calculated using the psych package (Revelle 2024).

A factor analysis was performed to identify the underlying factor structure of the items. The analysis explored solutions with 1 to 3 factors. The fit of the models was assessed using the lavaan package (Rosseel 2012).

2.4.2 | External Validity

External validity of the modified CKT was investigated by comparing the novice consumer group with the expert professional group. This was done by plotting the overall CKT score for each of the groups as well as plotting the two groups for each question. Significant differences between groups are tested using the Wilcoxon signed-rank test using the ggsignif R package (Ahlmann-Eltze and Patil 2021).

3 | Results

In this section, we explore the internal and external validity of the CKT. First, the internal validity is evaluated by analyzing the variability, consistency, and reliability of the CKT. Then, the external validity of the CKT is determined by analyzing the performance of the CKT in discriminating between novice consumers and coffee professionals.

3.1 | Internal Validity

The internal validity informs us about how well the scale performs regarding whether the items of the scale measure the

TABLE 3 | Count and percent of participants that answered correctly on individual questions. The total number of answers for all items is $n=267$. For Q1, the count is based on individuals answering all sub-items correctly; for Q9 and Q10, the count is for the answer given as 1, as there is no correct answer.

Item	Count of correct answers (%)
Q1	21 (7.9%)
Q2	100 (37.5%)
Q3	39 (14.6%)
Q4	43 (16.1%)
Q5	20 (7.5%)
Q6	48 (18.0%)
Q7	41 (15.4%)
Q8	54 (20.2%)
Q9	80 (30.0%)
Q10	64 (24.0%)

same underlying construct and if any of the items are redundant. This is evaluated through analysis of Item Variation, Item Correlation, and Scale Consistency.

3.1.1 | Item Variation

To investigate the variation in single items, the number and percentage of correct answers per item were calculated (see Table 3). There is variation across items as they differ markedly from 0% to 100%.

3.1.2 | Item Correlation

Figure 1 depicts the correlation between the 10 items. None of the items correlated highly, and the highest correlation was 0.67. At the same time, no item correlated negatively with another. This suggests sufficient coverage of the entire coffee expertise spectrum. Looking more closely at the data, the performative experience item (Q9) correlated least with the other epistemic knowledge-oriented items, whereas the question tapping into the

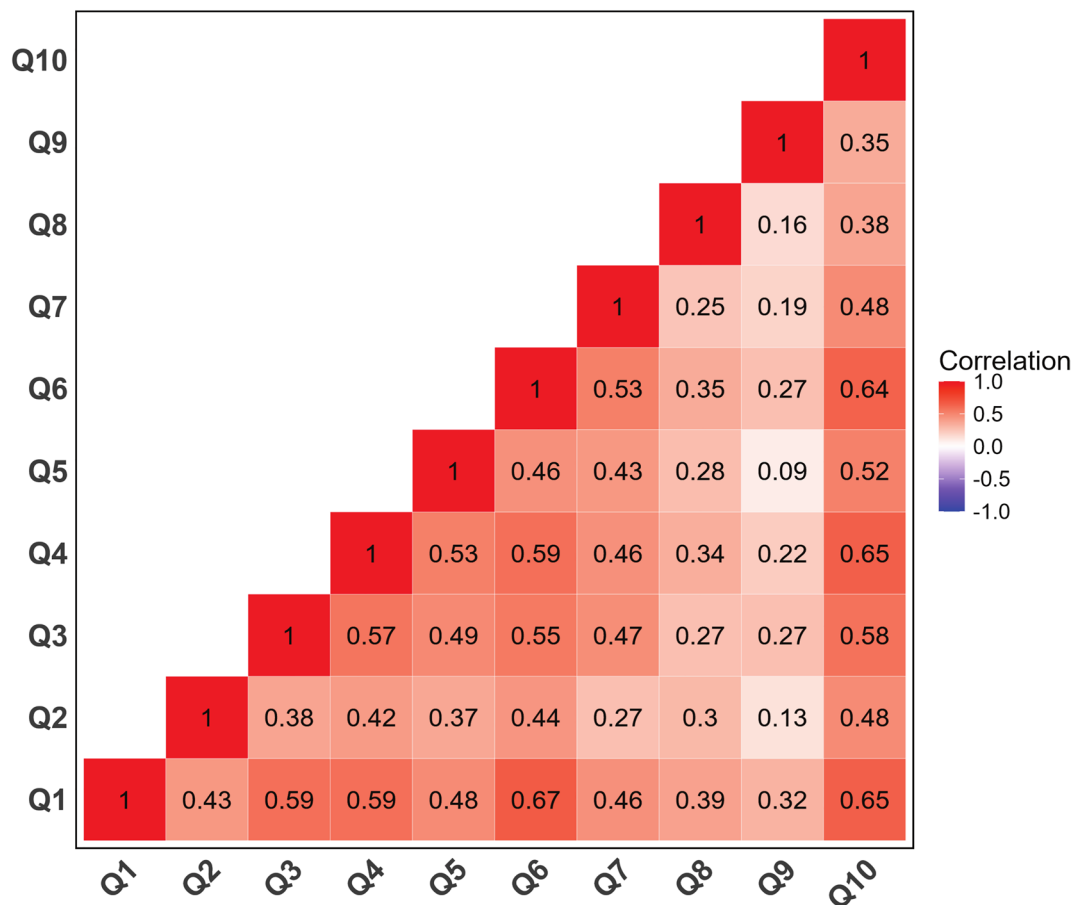


FIGURE 1 | Heatmap representing the correlation between the ten items of the CKT ($n=267$). The color intensity and numerical values within each cell indicate the strength and direction of the correlation between pairs of variables, with darker red indicating stronger positive correlations and lighter colors indicating weaker correlations.

TABLE 4 | Analysis of item consistency with the overall construct ($n=267$). Cronbach's α for the overall construct with all 10 items is 0.88. Cronbach's α after omission shows the construct with the nine remaining items if one is left out. Exploratory factor analysis with factor loadings for all items relying on one factor is included. All EFA loadings were significant at the 0.01 level.

Item	Cronbach's α after omission	Exploratory factor analysis
Q1	0.89	0.80
Q2	0.87	0.55
Q3	0.89	0.72
Q4	0.89	0.77
Q5	0.90	0.63
Q6	0.89	0.79
Q7	0.90	0.61
Q8	0.91	0.45
Q9	0.91	0.35
Q10	0.89	0.82

amount of education (i.e., how much reading on the subject had the participant done, Q10) did correlate highly with the knowledge questions (Q1–Q8), consistent with what might be expected.

3.1.3 | Scale Consistency

To confirm the consistency of the construct, Cronbach's α and factor analysis were conducted. Cronbach's α was run for the whole construct, and to test the impact of each item, we also ran a leave-one-out analysis with Cronbach's α . As displayed in Table 4, the overall construct showed a Cronbach's α of 0.88, which can be characterized as good (Cronbach 1951; Taber 2018). Further, the leave-one-out analysis showed only small improvements for all items.

For the exploratory factor analysis, models with one, two, and three factors were compared. Both AIC and BIC were lowest for the model with one factor. The factor loadings from the exploratory factor analysis are also shown in Table 4. A Very Simple Structure analysis corroborated this with the lowest BIC for one factor, and similar maximum complexity for one and two factors. Item Q9 has the lowest factor loading, which makes sense as it is the coffee intake item more related to performative expertise which might not correlate to the same degree with knowledge as epistemic knowledge questions.

3.2 | External Validity

External validity informs us how well the index detects differences in coffee knowledge between coffee professionals and novice consumers. This is visualized in Figure 2. Both the mean overall score and the mean scores of individual questions differ significantly between coffee professionals and novice consumers, indicating that the scale is able to differentiate between the

two groups. Again, Question 9 stands out as the item with the least difference between the two groups.

The Overall Coffee Knowledge Test score shows great discrimination between coffee professionals and consumer novices. However, there is a continuous distribution of scores across the spectrum from 0 to 8 (Figure 2).

4 | Discussion

This study investigated the validity of the 10-item modified CKT in evaluating coffee expertise. Measures of both internal and external validity were encouraging for the validity of CKT. For the internal validity, there was sufficient variation within the answers for all items, none of the items correlated highly, and no items correlated negatively with each other. The CKT had a good Cronbach α , and leaving one item out did not change the Cronbach α substantially. The factor analysis supported that all items were part of the same underlying concept.

The CKT discriminated well between coffee professionals and novice consumers. Coffee professionals performed significantly better in all the knowledge items (Q1–Q8) and gave significantly higher scores in the intake frequency item (Q9) and self-reported books about coffee read item (Q10).

The CKT contains two types of items, namely knowledge-based questions which can be false or correct (Q1–Q8), self-reported questions of intake (Q9), and reading (Q10) items. Even though all items seem to contribute to information that helps to differentiate coffee professionals from novice consumers, it could be argued that the two self-reported questions should be taken out and reported separately. Hughson and Boakes (2001) discussed this in relation to the Wine Knowledge Test, which was the model for the CKT. However, they argued that the reading item serves as a proxy for formal training. Seen in that light, the wording of the question or answer options for item Q10 might be re-considered to also include current information sources (i.e., add sources such as websites and YouTube videos).

In the context of the type of expertise, items Q1–Q8 in the CQT measure topic knowledge in the domain of coffee, and thus relate to epistemic expertise. Item Q9 relates to the performative dimension of coffee expertise—namely drinking coffee. The low correlation between this item and items Q1–Q8 seems to corroborate the dichotomy in expertise, meaning that you do not need to be an epistemic coffee expert to be a performative expert or, put more bluntly, you do not need to know anything about coffee varieties or coffee quality designations to be able to drink it. However, both are distinct types of coffee expertise and may play distinct roles in perception and cognition.

This validation study is limited to determining whether an individual is an expert or not. However, it could be argued that expertise is not binary, and one could possess levels of expertise. Melcher and Schooler (1996) included a third category, intermediate, in their wine expertise categorization. They argued that intermediates are individuals without formal training but with extensive knowledge. This could also be relevant with respect to coffee expertise. Thus, a possible future research direction could

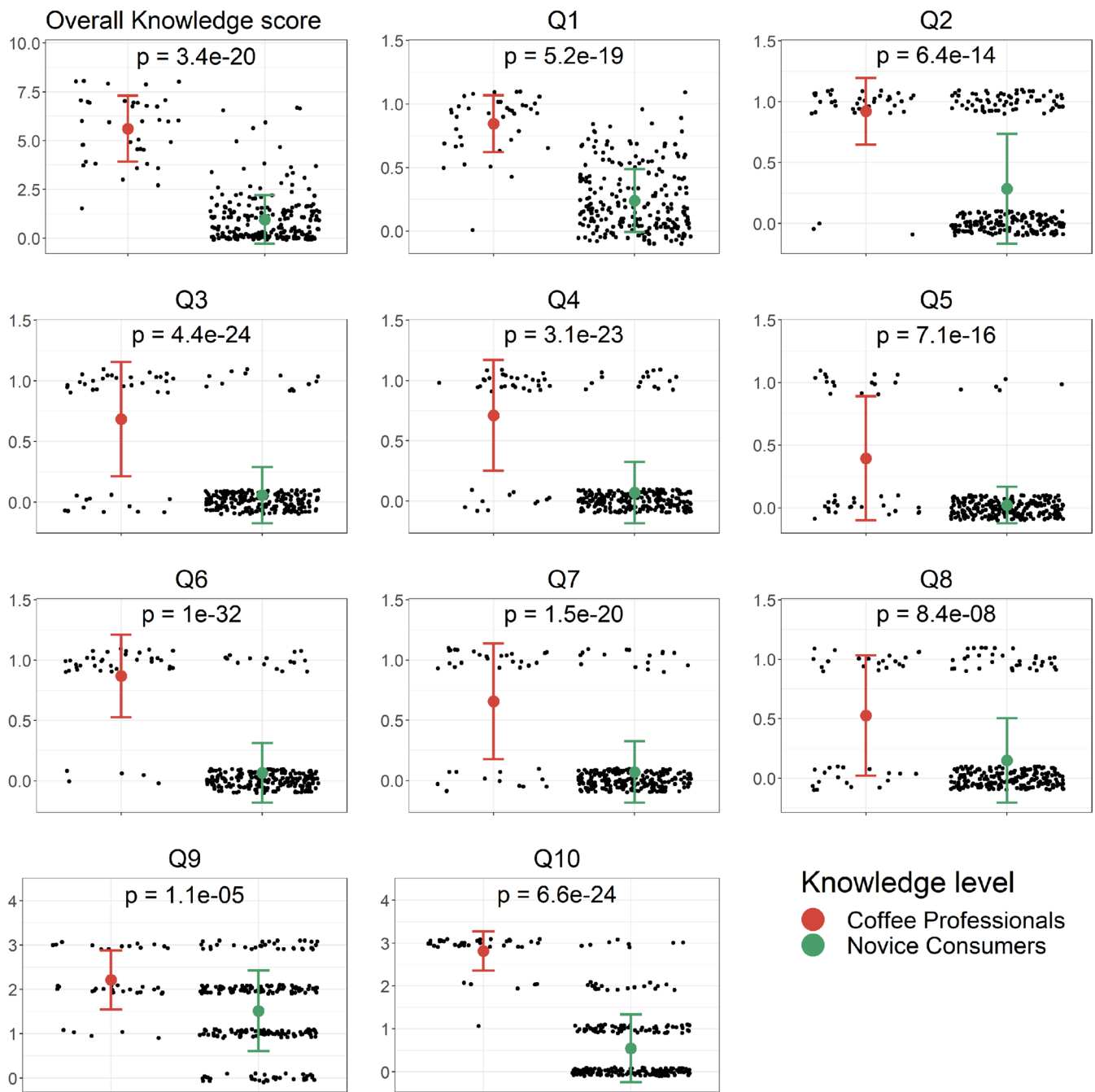


FIGURE 2 | First panel shows the difference in overall Coffee knowledge Test scores between novice consumers and coffee professionals, and subsequent panels show the difference for each individual question between the two groups. p -value in each plot indicates the significance level across groups.

be to investigate if the CKT could establish gradient levels of coffee expertise, and not merely whether an individual is a coffee expert or not.

4.1 | Limitations and Strengths

This study shows that the CKT performs well with respect to internal validity, in terms of item variation, correlation, and consistency. For external validity, CKT showed good discrimination between consumer novices and coffee professionals. This was even though the determination of an individual's status as an

expert or novice was defined by which occasion the data was obtained. Even though recruited as coffee professionals, the duration of their employment in the industry was not reported. If relatively newly employed in the coffee industry, a participant need not be a coffee expert to be a coffee professional. The same is the case for the novice consumers—one could be very interested and knowledgeable in coffee and without being a coffee professional. However, given the good discrimination between groups, this does not seem to be an issue.

The questionnaire was administered in English. Given the cognitive complexity of answering knowledge-based questions, this

might invoke limitations to this study. The performance of the CKT might be different when applied in a language with other linguistic features than English (Blasi et al. 2022). Conducted predominantly with participants from Minority World countries, this limitation could be expanded, as not only linguistic features, but differences in cultural features more broadly, might affect the performance of the CKT in discriminating experts from novices (Henrich et al. 2010; Raval et al. 2024). The vast majority of coffee is produced in the Majority World countries (Al-Abdulkader et al. 2018). This study cannot determine how the CKT performs in a coffee-producing country such as Brazil, where coffee plays a role in the national economy. Being a coffee professional in a coffee-producing country might also come with another skill set differing from what is evaluated in the CKT. That taken together, the validity of the CKT might be limited to the Minority World countries, a matter future studies could systematically explore.

5 | Conclusion

The performance of the 10-item CKT in determining coffee expertise was evaluated in this study. The CKT showed good internal and external validity, with scores indicating that all items contributed to the performance and the items measured the same underlying dimension. Furthermore, both the overall CKT score and the individual items discriminated well between novice consumers and expert professionals. All in all, this study suggests that the CKT is a suitable tool to determine whether an individual is a coffee expert or not, at least in Minority World countries.

Author Contributions

Jonas Yde Junge: conceptualization, data curation, formal analysis, investigation, project administration, methodology, visualization, writing – original draft. **Ilja Croijmans:** conceptualization, validation, writing – review and editing. **Line Ahm Mielby:** conceptualization, methodology, supervision, validation, writing – review and editing. **Asifa Majid:** conceptualization, validation, writing – review and editing. **Ulla Kidmose:** conceptualization, funding acquisition, project administration, methodology, supervision, validation, writing – review and editing.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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