



## Investigating adolescents' historical reasoning skills when analyzing and interpreting an image

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### ABSTRACT

This study investigated adolescents' (secondary school students,  $N = 145$ ,  $M$  age 13.9 years) historical reasoning skills when analyzing and interpreting an image. Presumably, historical reasoning can be fostered when engaging in inquiry-based writing. However, in past research using inquiry-based writing tasks, textual sources rather than images prevailed. The present research investigated students' writing skills when interpreting a historical image. Participants were presented with a historical photograph and were asked to write a structured text about their analysis and interpretation of this image. A scoring rubric was developed to assess the quality of students' historical reasoning skills, specifically: (1) asking and answering historical questions, (2) reasoning about images, and (3) reasoning with images. Findings show that the factor structure of the scoring rubric largely overlaps with theoretically distinguished components of historical reasoning. Students were able to ask historical questions and write a well-structured text. However, most students did not describe and analyze the source of the image and did not refer to the main message of the image. Further, many students could not identify the image's relevance for the present. Importantly, the findings imply that students' methodological competencies to critically analyze and interpret the used image were not elaborated. Possibly, they do not receive sufficient training addressing these skills. This seems problematic, not only in history education but also when deriving meaning from images in everyday life.

### KEYWORDS

Historical reasoning, Image analysis and interpretation, Historical writing

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## Introduction

Adolescents are increasingly confronted with historical content, for instance, through images and films on the internet (McGrew et al., 2018; Paxton & Marcus, 2018). Further, they increasingly produce digitally edited images and communicate through these (Külling et al., 2022). Images, especially photographs, are often presented uncontextualized and might mistakenly be considered accurate reflections of reality (Burke, 2008). Thus, adolescents need to develop competencies to analyze and interpret images from the past and present in a reflective and critical way.

Image interpretation skills are particularly crucial in history education, as images can reveal information that written sources possibly cannot. Historical images can give an eye-witness perception and provide insights into mentalities and cultural aspects of the society, particularly for periods when the skills to write about living conditions were limited in the population (Burke, 2008). Furthermore, to understand textual sources, different language levels might hinder accessing and interpreting these, e.g., the level of the source as a representation of past language acts (Handro, 2013). Images, due to their visual representation seem easier accessible.

In history lessons, the importance of images is recognized, and historical images are used extensively (Bernhard, 2017; Van Nieuwenhuysse et al., 2017). However, history textbooks and teachers seldomly create assignments asking for a thorough examination of images (Bernhard, 2017). Instead, images are mainly used for illustrative purposes rather than for discussion and contextualization, and students seem to inspect, analyze, and interpret images superficially (Bernhardt, 2007; Wolfrum & Sauer, 2007). Students rarely engage in writing tasks when learning with images, and a prolonged and elaborated examination of images in history lessons seems to fall short (Bernhard, 2017).

Considering the importance of images as historical sources, it seems important to investigate to what extent students are able to apply historical reasoning skills when working with images. Although there are indications that analytical skills are lacking, it is unclear to what extent students show historical reasoning competencies when learning with images. The present research aims to obtain insights into this, by analyzing to what extent aspects of historical reasoning are shown in students' written image interpretation.

### ***Aspects of historical reasoning***

A significant aim of history education is to teach students to reason historically. That means developing competencies to connect the past to the present and future by asking questions and analyzing and interpreting sources (Schreiber et al., 2006; Van Drie & Van Boxtel, 2008). The ability to develop historical questions has been described as a prerequisite for analyzing and interpreting historical sources (Van Boxtel et al., 2021).

However, very little empirical research addresses how students ask historical questions and connect historical significance with the relevance of the image for the present (Lévesque, 2005; Logtenberg, 2012, Phillips, 2002; Sebening, 2021). Logtenberg (2012) found that students can

formulate historical questions by themselves, although their questions are often descriptive (what/when/how questions). Sebening (2021) showed that students can express comparisons and analogies between the past and the present, but that these remain shallow, i.e., unreflective and contextless.

Importantly, when applying historical reasoning skills, students have to show that they are able to reason *about* as well as *with* the sources (Rouet et al., 1996). Reasoning about sources refers to students' skills to critically analyze the source and assess the value and the limits of information, including recognition of the author's perspective and aims and the context in which the source was produced. Wineburg (1991) identified three heuristics that historians apply while reading historical texts, i.e., sourcing, contextualization, and corroboration, which can be subsumed to reasoning about sources. Reasoning with sources refers to the skills involved in selecting information from sources and using this information to construct explanations about how the past is connected to the present (Lévesque, 2005; Phillips, 2002).

Although some adolescents as young as in eight grade are able to apply historical reasoning skills (De La Paz et al., 2014), it appears challenging for students to learn to reason about historical sources (De La Paz et al., 2012; Sendur et al., 2021). Students do not spontaneously apply strategies when reasoning *about* sources, such as sourcing, contextualization, and corroboration (Britt & Aglinskas, 2002; Nokes, 2017). Reasoning *with* sources is equally challenging for students because producing evidence-based interpretations using arguments is not commonplace at school (Britt & Aglinskas, 2002; De La Paz et al., 2017; Nokes & De la Paz, 2018; Waldis et al., 2020).

### ***Historical reasoning about and with images***

Learning with images is considered different from learning from texts, particularly when it comes to perception, analysis, and interpretation (Krammer, 2006; Lieber, 2013). Images are typically perceived for a shorter duration and given less attention than texts, even when these bring information that cannot be found in the text (Oestermeier & Eitel, 2014). Texts are typically processed in a fixed order, due to the linear structure, whereas an image leaves more room for dynamic processing (Oestermeier & Eitel, 2014). Possibly, learners presume that images are easier to understand than texts because images and their content can be captured quickly (Weidenmann, 1991). Because of this quick processing, an uncritical viewer may easily be deceived, e.g., by propaganda, and perceptions can be biased due to prior knowledge, experiences, and beliefs (Wolfrum & Sauer, 2007). Therefore, relevant information from the image might be unrecognized or ignored and this may lead to incomplete or false conclusions. Furthermore, Wolfrum & Sauer (2007) found that secondary school students rated information content higher in texts than images, whereas they judged meaning-making with images easier than with texts. It appears that, when analyzing and interpreting images, extra support is needed, because "no image explains itself", according to Gombrich (1984, p. 142). Generally, such support is given in textual information. Therefore, learners do not only need specific image interpretation competencies, but also text comprehension skills.

Students' historical reasoning competencies can be assessed by investigating the quality of their writing (Nokes & De la Paz, 2018). Commonly, inquiry-based writing tasks are used, which involve asking questions, searching and analyzing multiple sources as historical evidence, and interpreting these with arguments (Monte-Sano & De La Paz, 2012; Van Boxtel et al., 2021). In the present research, a historical writing task, i.e., writing an argumentative essay, is used to obtain insight into students' historical reasoning when learning with images. Besides being used for research purposes, inquiry-based writing tasks including argumentation can be beneficial for students in actual education, because they actively form their own conclusions instead of trying to understand a ready-made historical narrative (Van Boxtel et al., 2021). These tasks seem to have positive effects on starting historical reasoning processes and can foster students' analysis and interpretation of images by supporting them to examine information in-depth, and structure their thinking (Britt & Aglinskas, 2002; Rouet et al., 1996; Wiley & Voss, 1999).

Until present, students' competencies to interpret historical sources have mainly been investigated with the use of textual sources (Monte-Sano & De la Paz, 2012). To our knowledge, no studies assessed students' historical reasoning competencies when writing about their interpretation of images. When images are included in document sets, they mainly illustrate the content of predominant text sources, rather than serving as an independent source (Waldis et al., 2015).

Several models have been developed to score students historical reasoning. However, these tend to describe historical reasoning rather generally, and do not specifically assess students' historical reasoning when working with images as primary sources. For this study, assessing historical reasoning with images, components of the historical reasoning model by Schreiber et al. (2006) and components of image interpretation research by Bättschmann (2009) were used in conjunction to assess historical reasoning with images.

The present research investigates adolescent students' image interpretation, by assessing the quality of their essays. We investigated to what extent the scoring rubric distinguishes between components of historical reasoning. Even though inquiry-based writing tasks have mainly been used to assess historical reasoning with text sources, we expected that we would see similar historical reasoning processes when writing essays about images. According to our hypotheses, we addressed the following research questions:

RQ1: Can the developed scoring rubric be validated according to components of historical reasoning: (a) asking and answering historical questions; (b) reasoning about images (i.e., analyzing the image); and (c) reasoning with images (i.e., selecting and using information from prior analysis to explain the relevance of the image)?

RQ2: To what extent do students show competencies of historical reasoning in their essays about image interpretation?

## Methods

### *Participants and design*

Participants were 145 secondary school students ( $M$  age = 13.92,  $SD$  = .65; 50.3 % girls), who were either in the 8<sup>th</sup> grade at the end of the school year or the 9<sup>th</sup> graders at the beginning of the school year. Students were from the German-speaking part of Switzerland, and part of nine different school classes from four schools. All students had sufficient German skills to follow instruction in the German language. They were enrolled in lower secondary school, a three-to-four-year secondary school track (ranging from grade seven to nine, and a voluntary 10<sup>th</sup> grade). School tracks prepare students for a further education track, most often vocational education, but also a continuation to a gymnasium. On average, students obtained one to two hours of history education per week. Informed consent was given by their caretakers, and at the start, participants were told that they could drop out without any consequences. This study was part of a larger short-term longitudinal study with three measurement points, aiming to investigate potential changes in historical reasoning with images. The data for the present study was collected at the first measurement point.

### *Materials and procedure*

The image was a black and white photo by an unknown author from 1947. It showed two mid-aged women laughing about a voting poster in the background, at the time of the cantonal vote on women's suffrage in Zurich (Switzerland). The image was checked for its suitability and difficulty for the intended school level by teachers, art historians, and history educators. The image is owned by, and retrievable from Keystone-SDA (<https://tinyurl.com/39eh6n49>) or from a history textbook commonly used in Swiss schools (Fuchs et al., 2018, p. 78). To ensure that prior knowledge would be low, teachers confirmed that this image was not used in class before.

Additional information about the image background (85 words) and the context (129 words) was presented below the image. This information was based on a history textbook text about women's suffrage (Fuchs et al., 2018). The additional information did not reveal interpretive elements of the image itself.

After welcoming the students, the aim and procedure were explained (5 min). Then, students filled out online questionnaires (15 min). Due to the scope of the present paper, these questionnaires are not discussed further. Then, students were instructed (with a PowerPoint presentation) about the purpose of image analysis and interpretation, and how they could structure an image interpretation text with an introduction, main part, and conclusion (20 min). They were presented with a scheme showing the text structure (see Appendix 1). Afterwards, a sheet with an example text (see Appendix 2) and a corresponding image from a known curriculum topic (industrialization/child labor represented in the photograph by Lewis W. Hine, *John Howell an Indianapolis newsboy*, from 1908) was distributed to students for individual study (5 min) and was then collected again. The colors in the scheme and the example texts were the same, to support comparison between the scheme and the example text. The aim of the example text was to prepare students for the upcoming image interpretation and writing task.

After this instruction phase, students analyzed and interpreted the given image individually (40 min). Participants used a computer or tablet to search the internet for information to analyze the image. They received a handout with a visualization of the text structure (introduction, main part, conclusion), the prompt, the image with title and year of origin, a detailed caption (author, title, year, technique, publication details, and publication rights), additional information about the historical background and image context, and note paper to write down their image interpretation.

The prompt was: Give this image a meaning like a historian would do by using your collected information to write a meaningful image interpretation. Write a text of at least 300 words, taking the following criteria into account:

- Formulate a relevant question about the image, referring to the history and the present
- Mention the main message of the image, and describe the image accurately
- Summarize the information you collected (internet research/materials) to analyze the image
- Write a conclusion in which you present and justify your interpretation of the image

Students sat alone or visors were put up between students. Students self-paced their internet search and writing time. The researcher informed students 20 minutes before the lesson ended about the time left and recommended them to start writing if they had not yet started with that. After writing the image interpretation, texts were collected. Students who finished early could do an extra task: Finding differences between two images.

### ***Coding of the image analysis and interpretation***

To assess historical reasoning, a scoring rubric was developed, which combines generic historical reasoning components with specific image interpretation competencies (Kuckartz, 2014). The rubric was based on previous research (as outlined below) and on experiences with coding texts from students, who participated in a prior pilot study. Student texts were coded with MAXQDA version 2022. Coding was discussed by two raters. Before starting the individual coding process, two raters double-coded 10% of the texts, interrater reliability was high (Krippendorff's  $\alpha = .86$ ). After having coded approximately 50% the texts, the two raters double-coded 10% of the texts again, and interrater reliability was acceptable ( $\alpha = .78$ ). After both interrater reliability assessments, coding differences were discussed, and the codebook was adapted where needed. Then the two raters equally divided and rated the remaining texts.

The rubric consists of three components (asking and answering historical questions, reasoning about images, and reasoning with images), and a total of 10 categories indicating subcomponents



of these components (see Appendix 3). For each category, a participant could reach level zero (low quality) up to three (highest quality).

### *Component 1: Asking and answering historical questions*

Theoretically, this component consists of two subcomponents: (1) *Historical questioning*, and (2) *Answering the question*. Coding rated to what extent students described “a product or a (potential) start of historical reasoning while trying to put into words a conflict or deficit in prior knowledge about historical constructs, phenomena or developments” (Logtenberg, 2012, p. 91). When answering a historical question, it was rated to what extent students did this in a plausible way and justified their answer with reasons (Logtenberg, 2012).

### *Component 2: Reasoning about images*

For this component was scored to what extent students were able to identify and use historical information. This component was expected to consist of two subcomponents: (1) *Sourcing*, and (2) *Contextualization* (Reisman, 2012; Wineburg, 1991). For sourcing was rated to what extent information from the image caption was included in the written text, such as the name of the author, title, date, technique/type of image (genre), origin, and place of storage (Büttner, 2014). Contextualization addresses the context of the source such as information about the author, publication context, targeted audience, intention/motivation of the author making that image, and tendencies towards media critique (Britt & Aglinskis, 2002; Van Nieuwenhuysse et al., 2017).

### *Component 3: Reasoning with images*

For this component was assessed to what extent participants used sources and their analysis to describe and explain historical events or phenomena, based on their starting question (Krammer, 2006). Theoretically, this component consists of the subcomponents (1) *Image description*; (2) *Main message of the image*; (3) *Image interpretation*; (4) *Image reference*; (5) *Relevance for the present*, and (6) *Text structure*. For the image description was rated to what extent participants described the image or pictorial details in connection to aspects of the image composition (Bernhardt, 2007; Hamann, 2012; Krammer, 2006). To rate the main message of the image, the quality of the connection between the image and the historical event, and the inherent social issues were rated (Baxandall, 1990; Bernhardt, 2007). For the image interpretation was investigated to what extent connections between the image elements, the historical event, and social issues were explained and justified. To rate the image reference, the embedding of the image in the written product was investigated. When rating the component relevance for the present, it was assessed to what extent participants connected the past to the present, by explaining why historical events or social issues might be of today's importance (Lévesque, 2005; Phillips, 2002). With the rating of the text structure was assessed to what extent students could formally structure their texts with an introduction, a main part, and a conclusion.

### **Statistical analyses**

For each of the subcomponents, students received a score from zero to three. To investigate whether theoretical components of historical reasoning were shown in the scoring, an explorative factor analysis (using principal axis factoring) was conducted on the 10 subcomponents of the scoring with oblique rotation (direct oblimin). Based on the Kaisers criterium, only factors with eigenvalues greater than 1 were retained. Although EFAs based on polychoric matrices have been suggested for ordinal data, at least 300 observations per item are recommended to use this approach (Lloret et al., 2014). Our sample size ( $N = 145$ ) would be insufficient to use this approach. According to Robitzsch (2020), ordinal variables can be treated as continuous variables for EFA analyses, when items have three or more categories. As we had four categories per item, we decided to report our EFA based on the principal axis factoring approach with use of Pearson's correlation matrices. However, we also explored if factor loadings would be the same using the polychoric matrices approach, and no differences in the factor structure appeared.

Further, historical reasoning skills were investigated per subcomponent, and further, to investigate overall quality of historical reasoning, an overall score was calculated per student by adding up the ratings for the ten subcomponents. All analyses were conducted with SPSS version 27 and R, packages lavaan (Rosseel, 2012) and psych (vo.2.3.3; Revelle, 2023).

## Results

### *Validating the scoring rubric*

Internal consistency was acceptable, Cronbach's Alpha = .73, which implies that the scoring rubric had acceptable reliability. The scoring for the 10 subcomponents were added to conduct an exploratory factor analysis, the Kaiser-Meyer-Olkin measure verified the sampling adequacy, KMO = .62 (Kaiser & Rice, 1974). All KMO values for individual items, except for the subcomponent main message of the image with .41, were above the acceptable limit of .5 (Kaiser & Rice, 1974). We kept this item for theoretical reasons (as main message of the image is considered an aspect of image interpretation in previous work) but also because Cronbach's Alpha indicated good internal consistency when including all 10 coding categories. Four factors had Eigenvalues greater than 1, and these factors explained 69.38% of the variance. The factor loadings of the subcomponents are presented in Table 1.

**Table 1**

*Summary of exploratory factor analysis results for the SPSS Historical Reasoning Categories (N=145)*

Subcomponent	Rotated Factor Loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
Historical Questioning	<b>.65</b>	-.05	-.00	-.08
Answering the Question	<b>.71</b>	.04	.03	-.08
Text Structure	<b>.72</b>	-.03	.19	.18
Relevance for the Present	<b>.41</b>	.10	-.09	.11
Sourcing	.02	<b>.67</b>	.05	-.04
Contextualization	.01	<b>.72</b>	-.02	-.02
Image Description	-.05	-.00	<b>.92</b>	-.17
Image Reference	-.10	.26	<b>.59</b>	.22
Image Interpretation	.15	-.02	<b>.47</b>	.08
Main Message of the Image	.01	-.04	-.00	<b>.94</b>

*Note:* Factor loadings over 0.40 appear in bold.

As expected, historical questioning and answering the question loaded on the same factor (Factor 1), which likely indicates the theoretical component *asking and answering historical questions*. The subcomponents sourcing and contextualization loaded on Factor 2, which can be allocated to the historical reasoning component *reasoning about images*. The subcomponents image description, image reference, and image interpretation loaded on Factor 3, which matches the theoretical component *reasoning with images*. However, three more components that were expected to also load on this factor, relevance for the present, text structure, and main message of the image did not load on Factor 3. Instead, text structure and relevance for the present loaded on Factor 1, and the subcomponent main message of the image loaded on a separate factor (Factor 4). In sum, the

scoring rubric had acceptable internal consistency, and the EFA showed that historical reasoning consists of different components. There did not seem to be a full match with our expectations regarding the assignment of subcomponents to overarching components (based on theoretical ideas). However, the extracted factors largely overlap with the theoretically distinguished historical reasoning competencies, particularly *asking and answering historical questions*, *reasoning about sources*, and *reasoning with sources*.

### ***Students' historical reasoning competencies***

Overall, students could obtain a maximum of 30 points for their texts. The mean score was 10.63 points,  $SD = 4.91$ . The Shapiro-Wilk-Test indicated a normal distribution of the sum score,  $p > .05$ .

Further, we investigated to what extent students are able to apply historical reasoning competencies. Scores for the subcomponents are shown in Table 2. Overall, students were able to ask historical questions and to write a well-structured text. However, students' *reasoning about images* was poor; most students did not describe and analyze the source of the image. Furthermore, most students did not make any reference to the main message of the image, and almost half of the students were not able to identify the relevance of the image for the present.

**Table 2**

*Summary of frequencies in percentage for the SPSS (Sub)components of Historical Reasoning Categories (N=145)*

<b>(Sub)component</b>	<b>Level 0</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Median</b>
<b>Factor 1: Asking and Answering Historical Questions</b>					
Historical Questioning	14.5%	15.2%	55.2%	15.2%	Level 2
Answering the Question	33.1%	31.7%	26.9%	8.3%	Level 1
Text Structure	20%	26.2%	36.6%	17.2%	Level 2
Relevance for the Present	49%	26.9%	13.8%	10.3%	Level 1
<b>Factor 2: Reasoning about Images</b>					
Sourcing	59.3%	17.2%	13.1%	10.3%	Level 0
Contextualization	76.6%	15.2%	6.9%	1.4%	Level 0
<b>Factor 3: Reasoning with Images</b>					
Image Description	20%	44.8%	22.1%	13.1%	Level 1
Image Reference	9%	45.5%	31.7%	13.8%	Level 1
Image Interpretation	42.1%	42.1%	14.5%	1.4%	Level 1
<b>Factor 4: Describing the Main Message</b>					
Main Message of the Image	51.7%	15.9%	29.7%	2.8%	Level 0



## Discussion

Images are commonly used in history education with the aim to engage students' historical reasoning processes. The present study investigated adolescents' historical reasoning about and with an image using an inquiry-based writing task.

Our first aim was to investigate to what extent the scoring of students' essays showed similar components of historical reasoning as previous research using text sources, rather than images (RQ1). In line with our expectations, the developed scoring rubric differentiated between students' skills related to *asking and answering historical questions*; *reasoning about images*; and *reasoning with images*. This indicates that, as previously found with text sources (e.g., Rouet et al., 1996; Waldis et al., 2020), also image interpretation can be considered a multidimensional historical reasoning process.

However, the loading of specific subcomponents on overarching components did not entirely confirm our expectations. Particularly, we assumed that the subcomponents relevance for the present and text structure would belong to the component *reasoning with images*. Instead, these subcomponents were more closely related to the component *asking and answering historical questions*. These findings may not be surprising in the present context. In the writing prompt, students were instructed to try to connect their question to the present. The factor loadings indicate that answering the question and indicating the relevance for the present belong together. Moreover, text structure also loaded on this component. This would seem logical in this context: by asking a question and answering a question a text gets structured and framed.

Further, the subcomponent main message of the image was expected to belong to the component *reasoning with images*. Instead, this subcomponent came out as an independent factor. As further discussed below, formulating a main message appeared challenging for students. A preliminary image analysis is necessary to subsequently connect the image to history. However, image analysis skills appeared to be deficient. This may have influenced the findings about the categorization of this subcomponent. Future research could further address whether this subcomponent loads as an independent factor or should be subsumed to components of historical reasoning.

Our second research aim was to investigate to what extent students show historical reasoning competencies, i.e., *asking and answering historical questions*, *reasoning about*, and *reasoning with sources*, when interpreting a historical image (RQ2). Students were well able to formulate a historical question, which seems in line with findings on formulating historical questions about text sources by Logtenberg (2012). It has to be noted though that our findings show that most students asked descriptive questions, e.g., questions aiming at image comprehension. Such lower-order questions may not directly stimulate inquiry (Logtenberg, 2012). Thünemann (2009) suggests that students lack skills to formulate elaborated historical questions because they are typically not trained to do so in history education. Further, students were relatively well able to structure their text. Before starting the writing task, students were presented with an example text, which probably had positive effects.

Although students were able to ask (mainly descriptive) historical questions, answering these seemed challenging. Apparently, as also suggested by Logtenberg (2012), the quality of questions does not necessarily relate to the quality of historical reasoning processes when answering these. That is, elaborated questions do not automatically lead to elaborated answers. The scoring of the component *reasoning about images* brings insight into students' image analysis skills. Sourcing and contextualization were hardly visible in students' essays. Previous studies showed similar issues with students' image analysis (Bernhardt, 2007; Labischová, 2018; Lange, 2011; Wolfrum & Sauer, 2007). Although students were explicitly informed about the source (in the caption and the context description), most students ignored this information. This seems to indicate that students did not deal with the image as historical source.

To thoroughly interpret an image, an image description and an image analysis would seem important, as coded with *reasoning with images*. When describing an image, most students only

described a few pictorial details related to image composition. Often, the image description was fragmented, rather than being focused, and almost one-fourth of the students did not describe the image at all. This confirms findings by Labischová (2018) that students ignore pictorial details when interpreting a historical cartoon. Image details are often used to illustrate and emphasize its main message (Baxandall, 1990). However, results for the scoring of main message of the image shows that most students were not able to formulate this. When students described main messages, these were seldomly justified by relevant pictorial details. Instead, image descriptions often included irrelevant details. For the subcomponent image reference, most students received a low score. They did not put the image at the core of their interpretation and tended to focus more generally on the historical event without connecting it to the image. This may be a reason why many students cannot connect the image with a historical event/phenomenon and are unable to formulate a main message. When not connecting an image to the past, it would seem impossible to connect the image to the present. Indeed, our findings indicate that almost half of the students omitted the relevance for the present. When the description and the analysis of the image are incomplete or superficial, the interpretation most likely consists of false conclusions or overinterpretation. Findings that most students received low scores for image interpretation seem to confirm the importance of a thorough prior analysis.

The present research is the first to extend the findings previously found with text interpretation tasks to an image interpretation task. As for texts, also when using an image as historical source, it seems particularly challenging to reason about and reason with sources (Britt & Aglinskas, 2002; Nokes & De la Paz, 2018). Although, findings seem comparable to reasoning with textual sources, learning with images demands other skills to critically evaluate visual information. Research in history education about images does not reflect the prominent status of images in education and society. Our study is just one of a few which addresses that. In this study, one image, a photograph from 1947, was used for the image interpretation task. Future research should replicate the findings with different types of images. Further, although the findings of our study bring insights into strengths and weaknesses in adolescents' historical reasoning skills, participants were recruited from secondary schools in German-speaking areas in Switzerland. Future research should investigate generalizability of these findings and address if these can be replicated with different samples varying in e.g., language, different historical and cultural contexts, age level, and educational level.

This study is also one of the few which estimated construct validity of text ratings. This allows insights into the multidimensional construct of historical reasoning and the competencies which students should achieve when learning with images. In addition, our rubric might give orientation for practitioners and researchers when developing learning tasks or assessments. Importantly, the findings from the present study imply that students' methodological competencies to critically analyze and interpret the used image were not elaborated. This would seem problematic, not only in history education, but also in everyday life. In the last decades, images have become more accessible than ever before to adolescents (particularly due to the rise of social media), and often, images are manipulated and presented decontextualized. Our results show where specific skills may be lacking when dealing with images and indicate that only providing context information with an image may not be enough to support critical reasoning. Apparently, students need more support and training to learn how to analyze and interpret image sources. Future research should investigate how students can be supported with this process.

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## Appendix 1

### *Scheme of a Text Structure when Interpreting an Image*

<b>Question as title</b>
<p><i>Question related to the image, the historical event and the present day</i></p> <ul style="list-style-type: none"> <li>• What kind of question do I put in the center for my image interpretation that connects the image, the historical event and the present?</li> </ul>
<b>Introduction</b>
<p><i>Entry into the topic</i></p> <ul style="list-style-type: none"> <li>• How do I give the reader a brief overview of the topic? What is it about?</li> <li>• What is the goal of my image interpretation and how did I arrive at my question?</li> </ul>
<b>Main part</b>
<p><i>The main message of the image and appropriate image description</i></p> <ul style="list-style-type: none"> <li>• What is the main message of the image?</li> <li>• Image description: Which image details support my main message?</li> </ul>
<p><i>Summarizing the collected information in a meaningful way</i></p> <ul style="list-style-type: none"> <li>• Which of the information collected (research/materials) is relevant to understand and explain the image?</li> </ul>
<b>Conclusion</b>
<p><i>Answer to my question</i></p> <ul style="list-style-type: none"> <li>• What conclusion do I come to, and can I also justify this with the help of the information collected (research/materials)?</li> </ul>

## Appendix 2

### *Example text of an image interpretation*

Has the child labor shown in the photograph by Lewis W. Hine changed today?

In the time of industrialization, workers often earned too little money to be able to feed their families. For this reason, children also had to work hard. Employers took advantage of the children: Long hours, physically demanding jobs, and almost no pay. In addition, the work prevented them from going to school, which worsened their future prospects. With my image interpretation, I want to pursue the question of the extent to which the photographer was successful with his photos against child labor and whether the children are better off today than they were then.

The yellowish-brownish photo by Lewis W. Hine "John Howell, an Indianapolis newsboy" from 1908 documents the dark side of industrialization, child labor in the USA. In the foreground you can see the elongated shadow of the photographer and his camera, which is on a tripod. In the middle, the newspaper boy John Howell can be seen, holding the newspapers he wants to sell under his right arm. These appear huge in comparison to the boy. The newspaper boy looks small, helpless, and lost with his eyes downcast, even though he is in the center of the picture. This impression is reinforced by the photographer's long shadow and the tall streetlamp to his left. In addition, there are no people around him, which makes him even more lonely. In the background, there is a street corner with people walking.

Hine, a photographer, and teacher was working for the National Child Labor Committee at the time, so the welfare of children was important to him. This organization campaigned against child labor and wanted to make the public aware of the poor working conditions. Through Hine's photos, a larger audience could be made aware of the problem, as these were published by the NCLC in newspapers or their own publications.

The photographer advocated for the children by taking many photos that showed their poor working conditions. Hine and the NCLC hoped that by publishing the photos, child labor could be combated. Unfortunately, however, child labor was not banned in the U.S. until 30 years later, in 1938. Child labor was not only a problem then, but it still is today. In various countries around the world, children continue to be exploited in factories, in mining, or in tourism.

## Appendix 3

### Scoring rubric to assess historical reasoning components

	Level 0	Level 1	Level 2	Level 3
<b>Asking Historical Questions</b>	No question	No historical question	Historical question with 1 time reference point	Historical question with 2 time reference points
A historical question relates to the historical event/phenomenon and/or the inherent social issue present in the image		<b>or</b> no historical question but with 1 time reference point	<b>or</b> no historical question but with 2 time reference points <b>or</b> question aiming at image comprehension	<b>or</b> question aiming at more complex image comprehension with 2 time reference points
<b>Answering Historical Questions</b>	No answer to the question <b>or</b> no question has been asked	Answer is given but not supported with an argument <b>or</b> answer is false, unlogic	Answer is given and supported with 1 argument	Answer is given and supported with more than 1 argument
<b>Sourcing</b>	No sourcing	Sourcing with 1 aspect of image formation	Sourcing with 2 aspects of image formation	Sourcing with more than 2 aspects of image formation
-Author/employer -Technique/type of image -Title -Date -Place of origin/location				
<b>Contextualization</b>	No contextualization	Contextualization with 1 aspect about the context of the image	Contextualization with 2 aspects about the context of the image	Contextualization with more than 2 aspects about the context of the image
-Knowledge about the author -Publication context -Targeted audience -Intention/motivation of author -Tendency towards media critique				
<b>Image Description</b>	No image description	Image description with just a few image details connected to 0-1 aspect of image composition	Image description with several image details connected to 1-2 aspects of image composition	Image description with many or all image details connected with at least 3 aspects of image composition
-Color -Light-shadow -Relations -Perspectives -Fore-, middle-, and background -Facial expressions, gestures				

	Level 0	Level 1	Level 2	Level 3
<b>Main Message of the Image</b>	No main message of the image	Implicit main message of the image considering the historical event/phenomenon or the inherent social issue  <b>or</b> explicit main message of the image not considering the historical event/phenomenon or the inherent social issue  <b>or</b> main message of the image is false	Explicit main message of the image considering the historical event/phenomenon <b>or</b> the inherent social issue	Explicit main message of the image considering both, the historical event/phenomenon, <b>and</b> the inherent social issue
<b>Image Interpretation</b>	No connections between the image and the historical event/phenomenon and the inherent social issue  <b>or</b> connections are not explained/supported with arguments  <b>or</b> connections are false or overinterpreted	1 connection is explained and supported with an argument	Several connections are explained and supported with arguments  <b>or</b> a contrast/contradiction (image in the image) is noticed, but not explained/justified	Several connections are explained and supported with arguments  <b>and</b> a contrast/contradiction (image in the image) is noticed and explained/justified
<b>Image Reference</b>	No image reference	Tendency towards an image reference is apparent, and refers to less than half of the text	Image reference is partly apparent, and refers to the half of the text	Image reference is totally apparent, and refers to more than the half of the text
<b>Relevance for the Present</b>	No relevance for the present	Tendency towards a relevance for the present is apparent, but is unclear, or without connecting it to the historical event/phenomenon or the inherent social issue	Relevance for the present is partly apparent, but without giving a recent example  <b>or</b> a recent example was given, but is unclear	Relevance for the present is totally apparent and clearly explained with a recent example
<b>Text Structure</b>	Text is not structured, consisting of max. 2 elements	Tendency towards a structured text is apparent, consisting of max. 3-4 elements  <b>or</b> consisting of 4 elements but text is not structured with paragraphs	Text is partly structured consisting of at least 4 elements and text is clearly structured with paragraphs  <b>or</b> text is completely structured consisting of all 5 elements, but text is not always structured with paragraphs	Text is completely structured consisting of all the 5 elements  <b>and</b> text is clearly structured with an introduction, main part, and a conclusion with paragraphs
Consisting of 5 elements:  -asking a question (1 element)  -introduction (1 element)  -main part with image description & main message (2 elements)  -conclusion/answer (1 element)				