Attitudes towards invisible disabilities: Evidence from behavioral tendencies

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1.1. Author Note

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Abstract

Invisible disabilities account for 70-80% of all disabilities yet are often overlooked in social psychology research. Despite their prevalence, these conditions are frequently misunderstood and less recognized, leading to potential biases and negative perceptions. This research aims to address a critical knowledge gap by investigating attitudes toward invisible disability. We hypothesize that attitudes toward invisible disabilities are more negative than toward visible disabilities. Using an immersive behavioral tendency paradigm, the VAAST (Visual Approach/Avoidance by the Self Task), we were able to observe participants' approach/avoidance reactions in a simulated environment. Three studies (N_{total} = 444) were conducted. Studies 1 and 2 compared approach-avoidance tendencies towards visible and invisible disabilities, the former in the general population and the latter within a population of teachers. Study 3 used a variation of this paradigm, the Incidental-VAAST, to address control bias. Results, supported by multi-level frequentist and Bayesian statistics, as well as a mini meta-analysis, indicated consistently stronger negative attitudes towards invisible disabilities. By showing that individuals with invisible disabilities face greater prejudice than those with visible disabilities, this research advances our understanding of how visibility impacts social bias, adding depth to theories of prejudice.

Keywords: invisible disability, attitudes, behavioral tendencies, social cognition, prejudice

Background

The World Health Organization (WHO) predicts an increase in the number of people with disabilities due to population growth, aging, and increasing chronic health and mental conditions. Currently, invisible disabilities already account for 70-80% of all disabilities[1] (Kelly & Mutebi, 2023). Despite this prevalence, research and media still predominantly focus on visible disabilities. Disability is indeed often incorrectly viewed as a homogeneous category, which may obscure the diverse social realities and unique challenges faced by individuals with disabilities (Brinkman et al., 2022; Granjon, Rohmer, et al., 2023). The international disability symbol of a person in a wheelchair is a good illustration of this trend, leaving little room for the experiences of the vast majority of people with disabilities who have invisible impairments (Kelly & Mutebi, 2023). This narrow focus is akin to seeing only the tip of the iceberg, where the visible part represents the minority of disabilities, while the vast, submerged portion represents the invisible disabilities that remain largely overlooked. This oversight leads to a lack of understanding of the unique challenges faced by individuals with invisible disabilities (Abney et al., 2022), which, in turn, influences attitudes and reinforces prejudice (Lecomte et al., 2024). This study addresses an important gap in the literature by investigating how the visibility of a disability shapes approach-avoidance behaviors and, ultimately, discriminatory processes. This question is particularly timely given the growing awareness of invisible disabilities and their often deleterious consequences for social inclusion (Abney et al., 2022; Moriña, 2024). By examining behavioral tendencies towards invisible disability, this research provides a necessary foundation for advancing both theoretical and practical approaches to understanding ableism more broadly (Lecomte et al., 2024).

1.2. Social Reactions to (In)visible Disabilities

Disability is now widely characterized as an impairment of the body or mind that substantially limits functioning (e.g., walking, focusing) and constrains participation in regular daily activities (e.g.,

[1] Invisible Disabilities Association, 2012: https://invisibledisabilities.org/what-is-an-invisible-disability/

working, engaging in social and recreational activities; WHO, 2001). This definition covers both visible and invisible disabilities. Specifically, invisible disabilities encompass impairments that an observer may not easily recognize as the underlying cause is not directly observable, although certain behavioral indicators may suggest the presence of difficulties. The category of invisible disabilities includes a broad spectrum of diseases and disorders that hinder personal and social functioning, such as sensory disabilities (e.g., hearing impairments), autoimmune diseases (e.g., human immunodeficiency virus), chronic diseases (e.g., arthritis), cognitive disorders (e.g., attention-deficit/hyperactivity disorder), sleep disorders (e.g., sleep apnea), and psychological disorders (e.g., depression; Santuzzi et al., 2014). While having a disability increases the likelihood of experiencing less social inclusion (Dunn, 2019), this tends to be more pronounced for individuals with invisible disabilities (Colella, 2001; Mills, 2017; Newheiser & Barreto, 2014).

In educational environments, the disclosure of non-visible disabilities presents unique challenges, as such disabilities are often met with skepticism or stigmatization by peers and colleagues (Hassard et al., 2024). Teachers and other individuals who work in learning institutions may encounter barriers when seeking adjustments, as the absence of visible indicators of their disability can lead to misunderstandings or unwarranted scrutiny. As a consequence, teachers may exhibit more negative attitudes towards students with cognitive and behavioral disorders than towards those with physical disabilities (Cook, 2001; Jury et al., 2021). Research has drawn attention to the occurrence of microaggressions against individuals with invisible disabilities that indicate a worrying lack of recognition of their unique challenges, for instance, medical professionals who doubt symptoms, causing delayed diagnosis, and others who simply dismiss these disabilities (Olkin et al., 2019; Serpas et al., 2024). Furthermore, Mills (2017) confirmed that individuals with invisible disabilities who benefit from assistance dogs (e.g., individuals with hearing impairment) reported more discriminatory behaviors, intrusive questions, unwanted attention, and scrutiny of their adjustments by others, compared to individuals with visible disabilities (e.g., individuals with visual impairment). Thus, a more nuanced perception of the question of attitudes towards disability could be achieved by taking the visibility aspect into account.

Attitudes, defined as affective reactions or evaluations associated with social targets (Dovidio et al., 2010), have attracted increasing attention in disability research over the past three decades. This increase in interest has occurred in parallel with growing public awareness of the importance of equal opportunities and rights for people with disabilities (Wilson & Scior, 2014). However, assessing attitudes towards disability is a significant challenge, primarily due to concerns about social desirability (Antonak & Livneh, 2000; Crandall et al., 2002). When participants are aware that their attitudes towards disability are being evaluated, they may adjust their responses to align with socially acceptable norms, thereby introducing social desirability bias. This can lead to control bias, where responses reflect what is expected rather than genuine beliefs. In the context of disability, the suppression of prejudice is often driven by a desire to conform to perceived social norms concerning the appropriateness of expressing certain "acceptable" beliefs and feelings (Crandall et al., 2002). To address these issues, researchers have increasingly employed more indirect measures that have revealed generally negative underlying attitudes (Dovidio et al., 2011; Granjon, Doignon-Camus, et al., 2023; Rohmer et al., 2022; Schimchowitsch & Rohmer, 2016; VanPuymbrouck et al., 2020). For instance, in a recent systematic review and meta-analysis that examined attitudes toward individuals with disabilities, assessed using indirect measures, Antonopoulos et al. (2023) found an overall moderate but significant association between words with a negative valence (i.e., incompetence) and disability. Notably, these findings indicated a minimal or absent correlation with self-reported measures of attitudes (Lacruz-Pérez et al., 2023; Wilson & Scior, 2014). Importantly, previous research has primarily focused on prototypical physical disabilities (e.g., people in wheelchairs), leading a reconsideration of the generalizability of the findings to the wide range of disability situations. The present research aims to overcome this limitation by taking the visibility of disability into account.

1.3. Measuring Attitudes through Approach/Avoidance Tendencies

Traditional reaction time measures used to study attitudes (e.g., the Implicit Association Test, affective priming tasks) have raised reliability and reproducibility concerns. These concerns stem from the sensitivity of the test to situational factors and cultural biases; the ability of the Implicit Association Test? to predict real-world behavior has also been questioned (Jost, 2019; Oswald et al., 2013, 2015; Payne et al., 2008, 2017). To address these challenges, we propose a promising alternative, the Visual Approach/Avoidance by the Self Task (VAAST) that integrates the simulation of visually perceived movements of the whole self to assess approach/avoidance tendencies (Rougier et al., 2018). In this task, participants are immersed in a realistic environment where their spontaneous approach and avoidance reactions towards a target are assessed.

The VAAST is based on the embodied cognition concept stating that the acquisition of object representations in memory is rooted in sensorimotor experiences (Barsalou, 2008; Matheson & Barsalou, 2018; Versace et al., 2014), meaning that memory encodes perceptual inputs linked to bodily movement toward or away from an object. The VAAST's simulated visual enlargement (vs. shrinking) of a stimulus establishes consistency (vs. discrepancy) with stored perceptual inputs from previous experiences, is rooted in the observation that the object was perceived positively (vs. negatively), and hence influences the individual's approach or avoidance behavior. If sensorimotor information is stored in memory, then associated actions are too (Barsalou, 1999, 2008; Damasio, 1989; Niedenthal, 2007; Versace et al., 2014). The simulated visual flow directly refers to the experience individuals have when interacting with their environment. A task that only simulates a movement of the object would not properly simulate an action that is compatible with the experience in the individual's memory because it is generally the individuals who approach or move away from the objects and not the reverse (Eder et al., 2021; Rougier et al., 2018). The better a task recreates a lived experience, the more accurately it measures the effect (Versace et al., 2014). For example, Aubé et al. (2021) found that participants exhibited a quicker propensity to avoid children with autism compared to neurotypical children - supposedly influenced by negative attitudes grounded in past experiences with autism, whether encountered in real life or through the media (Niedenthal et al., 2005). Therefore, due to its theoretical foundation and to its closeness to individuals' experiential reality, the VAAST yields more substantial and consistent effects than traditional approach/avoidance tasks, such as the Manikin task (Rougier et al., 2018). The VAAST also addresses a common limitation of indirect measures of attitudes: determining whether they solely capture mere cultural knowledge (i.e., societal beliefs and values about social groups, Payne et al., 2017) or if they go further by encompassing personal attitudes. Indeed, Rougier et al. (2020) demonstrated that VAAST captures pro-ingroup effects even in groups associated with negatively valanced cultural knowledge (e.g., North African groups). Based on their approach/avoidance scores it was possible to generate approach/avoidance effects contingent upon individuals' actual social group membership.

In light of these considerations, the VAAST is a suitable tool to address the main objective of this research, i.e. to investigate whether attitudes vary based on the visibility of disabilities. By investigating biases against invisible disabilities, this research constitutes a first necessary step to inform the development of targeted interventions, such as awareness-raising campaigns and inclusivity training, tailored to support individuals with these disabilities. The insights gained may also help create more inclusive practices and policies, ultimately fostering equitable treatment and promoting the social participation of this often-overlooked population. Given the implications for inclusive environments across workplaces, educational institutions, and social policy, understanding the specific biases that affect individuals with invisible disabilities is crucial (Hassard et al., 2024).

1.4. Overview and Hypotheses

Building on field studies focused on the lived experiences of individuals with disabilities, our hypothesis gets rounds the limitations of traditional psychosocial models, by offering a data-driven approach that uncovers insights that are often missed by theoretical frameworks. We examined how attitudes towards disability vary depending on visibility by measuring spontaneous behavioral tendencies using the VAAST (Aubé et al., 2019; Rougier et al., 2018). In Study 1, we compared approach-avoidance tendencies towards individuals with visible *versus* invisible disabilities. Study 2 replicated this design with teachers who address diversity-related themes in their work. For these two studies, we hypothesized that participants would display stronger approach tendencies towards visible disabilities (vs. invisible disabilities), while exhibiting stronger avoidance tendencies towards invisible disabilities (vs. visible disabilities). Specifically, in the approach condition, we anticipated longer reaction times for categorizing invisible disability items compared to visible disability ones. Conversely, in the avoidance condition, we expected shorter reaction times for categorizing invisible disability items compared to visible disability ones. To mitigate potential control bias when the evaluation object is explicit, as well as the artificiality of direct comparisons between visible and invisible disability, Study 3 employed an Incidental-VAAST. This adapted version of VAAST assesses behavioral responses more subtly, by evaluating to what extent exposure to affective stimuli (here, visible vs. invisible disabilities) can elicit approach/avoidance tendencies towards unrelated neutral objects (geometric shapes, Pillaud & Ric, 2022). We hypothesized that prior exposure to visible disabilities (vs. invisible disabilities) would trigger faster approach reactions (i.e., shorter reaction times to approach) while prior exposure to invisible disabilities (vs. visible disabilities) would trigger faster avoidance reactions (i.e., shorter reaction times to avoid) related to neutral stimuli. It is important to note that visible and invisible disabilities encompass all types of disabilities, including physical, mental, sensory, and cognitive categories, as is recognized in standard disability categorization worldwide. To ensure the reliability of our findings, we engaged in replication efforts and diversified our inferential analysis approaches, incorporating both frequentist and Bayesian methods, as well as conducting a mini meta-analysis.

Ethical and Transparent Practices

Institutional approval of the protocol was obtained (accreditation number: CER/ Unistra /2018 09). The studies were pre-registered. For Study 1, see: https://osf.io/sugkr/?view_only=82893f4e4a5742ea89186f07b3208946 (Study 3 in pre-registration). For Study 2, see: https://osf.io/skmyr/?view_only=74eebdeb04364ace8334f11a97dbd2c8. For Study 3, see: https://osf.io/49nhv/?view_only=64b3677a6df64e96a022eb569d230ecc. Please note that Studies 1 and 2 were part of a larger project that included other measurements[2] (see OSF for details). All materials and Rscripts are accessible on OSF: https://osf.io/43yjc/?view_only=66665a8c73c446e099756ee5cf4fda24. All studies, measures, manipulations, and data/participant exclusions are fully and transparently reported in the manuscript or on OSF.

Pilot Study

To operationalize visible and invisible disability categories, we conducted a pilot study to collect exemplars of both types of disabilities spontaneously mentioned by participants. We selected the most frequently quoted exemplars (25 in all) based on the words generated by the participants in a previous study (see Granjon, Rohmer, et al., 2023). Next, we recruited 55 participants (M_{age} = 26.06, SD_{age} = 9.41, 19 women and 36 men) who had not taken part in the main studies to complete a short online survey (on Qualtrics, Provo, UT). Each participant randomly rated 13 out of the 25 words on a 7-point scale based on three criteria: the extent to which each disability was (1) representative of disability, (2) visible, and (3) serious. Each disability was assessed by 20 to 30 participants. We selected the words that were most representative of the concept of disability, and then classified them based on the visible or invisible criteria. Finally, we controlled for the seriousness criteria to select the stimuli (Crandall & Moriarty, 1995, see details on OSF). We selected eight items for each category, encompassing disabilities or diseases/impairments that can result in a disability. These categories

[2] Specifically, measures of stereotype were also included (see Granjon, Rohmer, et al., 2023)

include physical disabilities, mental disabilities, sensory disabilities, and chronic health conditions[3]. Note that these labels are similar to those selected in prior studies (Granjon, Rohmer, et al., 2023).

Study 1

The objective of Study 1 was to investigate attitudes towards visible disabilities in comparison to invisible disabilities using an immersive approach-avoidance tendencies paradigm (VAAST).

4.1. Participants and Design

Based on past studies on approach/avoidance tendencies applied to intergroup attitudes using VAAST (Rougier et al., 2020), we expected a low effect size (d = 0.2) with a fixed α-level (.05). For a high statistical power of .90, the required sample was estimated at 216 participants, for a within-participant design using Gpower 3.1. We recruited 219 French participants (M_{age} = 24.77, SD_{age} = 17.79, 144 women, 68 men, 3 non-binary persons and 4 unspecified) through an online platform (PsyToolKit, Stoet, 2010, 2017) using social media. We used a 2 (visible vs. invisible disability) x 2 (approach vs. avoidance) within-participant design. This sample size provided 80% power to detect an effect size of d = 0. 27 or greater with a 5% false-positive rate.

4.2. Material

The VAAST uses sensorimotor elements to create a virtual street environment for participants. Like in a video game, participants are able to simulate movement along the street, while stimuli are presented sequentially in the center of the background (i.e. the street). Sixteen stimuli were selected based on the pilot study and used as test exemplars in the present study. Six extra words in addition to those in the testing phase were used in the training phase (3 related to visible disability and 3 to invisible disability). The task consisted of a compatible block trial (approaching stimuli related to visible disability and avoiding stimuli related to invisible disability) and an incompatible one (avoiding stimuli

[3] The material, corresponding to the specific labels viewed by participants, included the following items: *wheelchair, hemiplegic, tetraplegic, amputee, paralyzed, Down's syndrome, malformed, and dwarf* (visible disability conditions); and *deaf, mute, schizophrenic, intellectually disabled, hemophiliac, autistic, cystic fibrosis, and diabetic* (invisible disability conditions).

related to visible disability and approaching stimuli related to invisible disability). The order of blocks was counterbalanced between participants. Depending on the stimuli and instructions, participants had to move forward by pressing the Y key or backward by pressing the N key. For example, the instructions for the compatible block were: “Move forward for the words representing visible disability by pressing the Y key, and move backwards for the words representing invisible disability by pressing the N key”. In the instructions for the incompatible block, the categories of disability were reversed to correspond to the other key. The impression of whole-body movement was elicited by the dynamic zooming in/out of words (by approximately 13%) in response to critical stimuli within the virtual street. Additionally, the visual flow of the entire environment mirrored the sensation of moving towards/away from the stimulus (see Figure 1). The training stage was performed before each critical block. Feedback was displayed on the screen in the form of an error message – only in the training phase. The test followed the training. Each stimulus was presented three times within each block, so that participants performed 96 trials in all (48 trials in each block). Words were separated by a 500-ms interval. The block order was counter-balanced between participants.

Figure 1.

Schematic representation of a VAAST trial when the participant is instructed to avoid stimuli related to invisible disabilities (Study 1).

4.3. Procedure

The study comprised several stages. First, a short text with the definitions of both invisible and visible disability was displayed (see supplementary material on OSF). The two conditions of disability were presented to each participant. Second, to ensure that participants correctly assigned words in each category (i.e., visible vs. invisible), they performed a categorization task comprising the 16 stimuli used in the VAAST. The task consisted of ascribing each word to the category to which it belonged as quickly as possible (e.g., "*asthmatic*" for invisible disability, by pressing the '←' key; "*quadriplegic*" for visible disability, by pressing the '→' key). Direct feedback appeared on the screen after each word (in the form of a happy or unhappy emoticon). Next, the categorization had to be performed a second time, with additional instructions to respond as quickly as possible. Third, to provide more meaning and context to the experimental situation, an interdependent scenario was established, as attitudes towards disability are more likely to be triggered in interpersonal encounters (Fiske & Bai, 2020). To this end, the participants were informed that they had to collaborate with a work colleague with a disability, who was abroad, to construct and submit a work project before a given deadline. Successful cooperation with this colleague would lead to the possibility of promotion (see supplementary material on OSF). Fourth, participants performed the first block of the VAAST – the compatible or incompatible block depending on the counterbalancing – and the second block of the VAAST. Fifth, socio-demographic data, including age (ranging from 18 to 100 on a slider), gender (with options for men, women, non-binary, and other), and education level (from high school diploma to PhD), were provided through selectable choices. Finally, participants were asked to indicate their familiarity with disability issues, as this familiarity is a potential confounding variable (Corrigan & Nieweglowski, 2019; McManus et al., 2011). Informed consent was obtained from all participants prior to the start of the study. By proceeding to the next page, participants indicated their agreement for their anonymized data to be used for scientific purposes. They were also informed that they could withdraw their data at any time before publication.

4.4. Results

Data from specific training blocks were excluded from the analysis. Participants with an error rate exceeding 30% were also excluded, which resulted in the removal of 11 participants. Reaction times (RTs) for correct responses were analyzed (errors = 4.67% of the data). Based on RT distribution (Ratcliff, 1993), RTs below 300 ms and above 3000 ms were excluded (2.97% of the data). The data were then log-transformed to normalize the distribution of the RTs (Ratcliff, 1993) and were analyzed using mixed-model analyses (Westfall et al., 2014)[4]. We estimated a model with the category of stimuli, movement and all the products of these variables as fixed effects, and we estimated the random intercepts and slopes for participants, stimuli and their interaction (Judd et al., 2017; see supplementary analyses on OSF, Table S1). Other filters and transformations were tested and gave relatively similar results (see supplementary analyzes on OSF; Table S2). Effect sizes (d_z) were estimated based on a classical ANOVA, as there is still no consensus about the calculation of effect sizes with mixed models (Rougier et al., 2018). For the sake of readability, we report untransformed means in the manuscript. We also computed the rate of participants and stimuli for which the effect

[4] The exclusion criteria differed from those in the preregistration, and the preregistration did not anticipate any transformations of the reaction time data or mixed model analyses. These adjustments were made for the sake of consistency across our three studies and to apply a more conservative approach in line with the methodology outlined by Rougier et al. (2018).

was in the direction of the reported effects (see supplementary analyses on OSF, Table S3). The data were submitted to a 2 (Movement: approach vs. avoidance) x2 (Category: visible vs. invisible) mixed-model analysis. All Cis, for the three studies, were 95% confidence intervals.

The analysis did not reveal an effect of the movement, $t(198.7) = 0.69$, $p = .49$, 95% CI [-0.015; 0.007], $d_z = 0.04$, but did reveal an effect of the category, $t(200.6) = -5.91$, $p < .001$, 95% CI [-0.050; -0.025], $d_z = 0.41$, where participants categorized visible disability-related stimuli more rapidly than invisible ones (see Table 1 for descriptive analyses). More importantly, the predicted Category x Movement interaction was significant, $t(204.9) = 9.52$, $p < .001$, 95% CI [-0.20; -0.13], $d_z = 0.67$ (see Figure 2). In the avoidance condition, participants categorized invisible disability items more rapidly than visible ones, $t(206.3) = 4.77$, $p < .001$, 95% CI [0.027; 0.063], $d_z = 0.33$. Inversely, in the approach condition, participants categorized visible disability items more rapidly than invisible ones, $t(202.1) = -10.91$, $p < .001$, 95% CI [-0.144; -0.097], $d_z = 0.70$. Finally, the interaction between category and movement remained significant after controlling for familiarity with disability, $t(203.9) = 9.36$, $p < .001$, 95% CI [0.130, 0.199], $d_z = 0.68$.

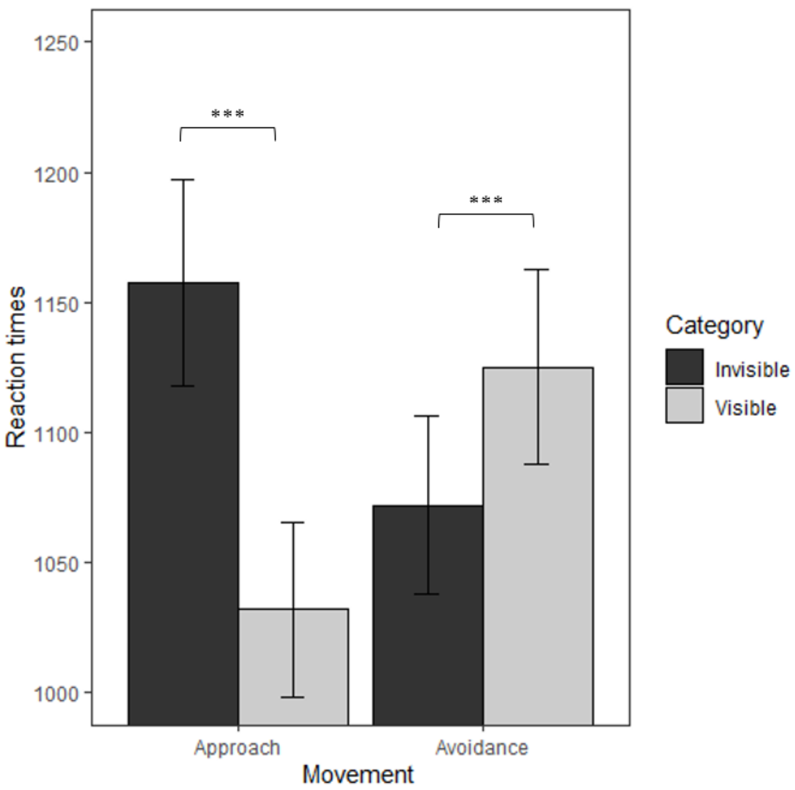
Table 1

*Descriptive mean and standard error response time (in milliseconds) in the VAAST as a function of disability and movement (*N *= 204, Study 1).*

	Visible disability		Invisible disability		*Movement*	
	M	*SE*	*M*	*SE*	*M*	*SE*
Approach	1031.96	28.82	1157.70	34.30	*1093.03*	*31.90*
Avoid	1125.15	32.13	1072.09	29.37	*1098.93*	*30.85*
Disability	*1079.04*	*30.71*	*1113.72*	*32.00*		

Figure 2.

Means and standard errors of untransformed response time (in milliseconds) as a function of category and movement (Study 1).



Note: p < .001 (***)

4.5. Discussion concerning Study 1

Study 1 showed that participants were slower to approach invisible disabilities than visible ones, whereas the reverse was observed for avoidance tendencies. This offers preliminary experimental evidence that individuals with invisible disabilities are associated with more negative attitudes than individuals with visible disabilities. To further explore this question, Study 2 focused on a population directly involved with the issue of inclusion in their daily professional lives: teachers (Symeonidou, 2017). Indeed, recent studies have shown that there are more negative self-reported attitudes towards students with invisible disabilities, such as learning difficulties, compared to visible disabilities like children in wheelchairs (Jury et al., 2021). Gaining an understanding of teachers' inclination to approach or avoid disabilities in a broader context would offer valuable insights into the challenges of implementing inclusive education (Stanczak et al., 2024).

Study 2

The goal of Study 2 was to replicate the findings of Study 1, examining approach-avoidance tendencies towards visible disabilities *versus* invisible disabilities, within a population of teachers who have to directly deal with the issue of inclusion of students with disabilities in class on a daily basis.

5.1. Participants and Design

Based on Study 1, we would expect a large effect size (d = 0.67). However, as it was the first study to test this relation, we chose to select an intermediate effect size (d = 0.40) with a fixed α -level (.05) and a high statistic power of .90, using Gpower 3.1. Following this procedure, the required sample size is at least 44 participants in all. In order to prevent data loss, we recruited 84 French elementary school teachers (M_{age} = 36.94, SD_{age} = 11.26, 78 women and 6 men) through an online platform (PsyToolKit, Stoet, 2010, 2017). We used a 2 (visible vs. invisible disability) x 2 (approach vs. avoidance) within-participant design. The average number of years of teaching was M = 12.84 (Min = 0.5; Max = 40). This sample size provided 80% power to detect an effect size of d = 0. 45 or greater with a 5% false-positive rate.

5.2. Material and Procedure

An identical VAAST to that used in Study 1 was used. The procedure used in Study 2 was also identical to that used in Study 1, except for the interdependent context displayed prior to the VAAST. Indeed, to align with the teacher job scenario in Study 2, participants were told they were expected to include a student with a disability in their class. Being able to optimally communicate with this student would lead to opportunities for promotion (for more information, see OSF). Additionally, we included a question about the number of years participants had been teaching to determine if teaching experience could be a confounding variable (Avramidis & Kalyva, 2007). Informed consent was obtained from all participants prior to the start of the study. By proceeding to the next page, participants indicated their agreement for their anonymized data to be used for scientific purposes. They were also informed that they could withdraw their data at any time before publication.

5.3. Results

Data from specific training blocks were excluded from the analysis. Participants with an error rate exceeding 30% were also excluded, resulting in the removal of 1 participant. Like in Study 1, only correct responses were analyzed (errors = 5.08% of the data). Based on RT distribution (Ratcliff, 1993), RTs < 300 ms and > 3000 ms were excluded (4.36% of the data). The data were log transformed in order to normalize their distribution (Ratcliff, 1993). Moreover, other filters and transformations were tested with relatively similar results (see supplementary analyzes on OSF; Table S5) [5]. We also computed the rate of participants and stimuli for which the effect was in the direction of the reported effects (see supplementary analyzes on OSF, Table S6). Like in Study 1, the data were submitted to a 2 (Movement: approach vs. avoidance) x2 (Category: visible vs. invisible) mixed-model analysis. The estimation of the random effect is detailed in supplementary analyses on OSF (see Table S4).

The results were similar to those obtained in Study 1. The analyses did not reveal an effect of the movement, $t(81.7) = -0.44$, $p = .66$, 95% CI [-0.02; 0.01], $d_z = 0.07$, but did reveal an effect of the category, $t(78.5) = -4.57$, $p < .001$, 95% CI [-0.08; -0.03], $d_z = 0.50$, where participants categorized visible disability-related stimuli more rapidly than invisible ones ($p < .001$, see Table 2 for descriptive analyses). More importantly, the predicted Category x Movement interaction was significant, $t(78.0) = 4.18$, $p < .001$, 95% CI [0.08; 0.21], $d_z = 0.45$ (see Figure 3). The moderation is explained by the approach condition, wherein participants categorized visible disability items more rapidly than invisible ones, $t(78.5) = -6.74$, $p < .001$, 95% CI [-0.164; -0.090], $d_z = 0.74$. No simple effect was observed in the avoidance condition, $t(78.2) = -0.40$, $p = .69$, 95% CI [-0.030; 0.060], $d_z = 0.06$. The interaction between category and movement remained significant after controlling for the number of years of teaching, $t(73.7) = 4.38$, $p < .001$, 95% CI [0.082; 0.25], $d_z = 0.47$.

[5] The exclusion criteria differed from those in the preregistration, and the preregistration did not anticipate any transformations of the reaction time data or mixed model analyses. These adjustments were made for the sake of consistency across our three studies and to apply a more conservative approach in line with the methodology outlined by Rougier et al. (2018).

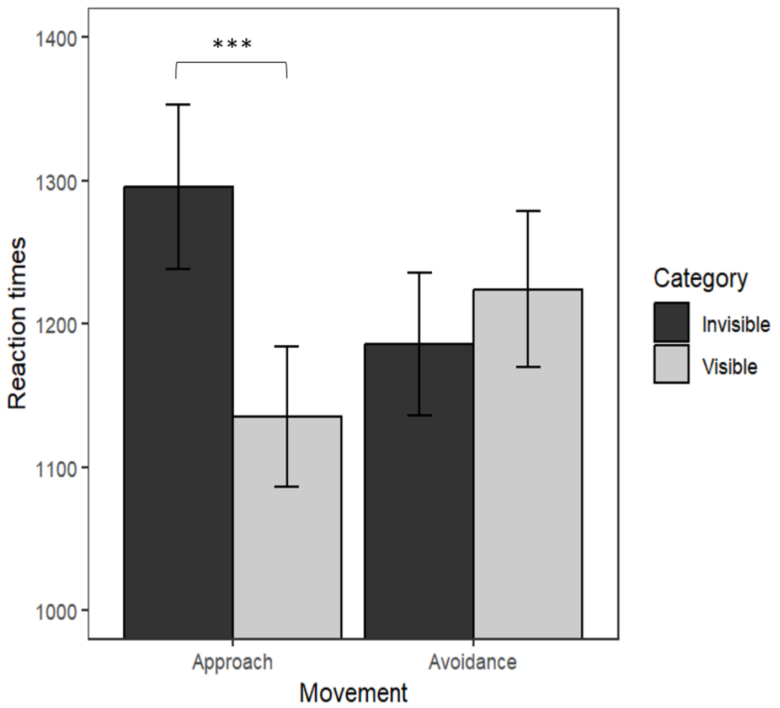
Table 2

*Descriptive mean and standard error response time (in milliseconds) in the VAAST as a function of disability and movement (*N *= 84, Study 2).*

	Visible disability		Invisible disability		*Movement*	
	M	*SE*	*M*	*SE*	*M*	*SE*
Approach	1135.43	49.01	1295.38	57.31	*1213.03*	*53.90*
Avoid	1224.29	54.24	1185.96	50.05	*1205.42*	*52.25*
Disability	*1180.22*	*51.93*	*1239.45*	*54.04*		

Figure 3.

Means and standard errors of untransformed response time (in milliseconds) as a function of category and movement (Study 2).



Note: p < .001 (***)

5.4. Discussion concerning Study 2

Focused on a specific population involved in inclusive professional practices, Study 2 showed that behavioral tendencies are moderated by the visibility of disabilities. Consistent with Study 1, participants showed a preference for approaching individuals with visible disabilities over those with invisible disabilities, indicating stronger negative attitudes towards invisible disabilities. Notably, the absence of a simple effect in the avoidance condition may be attributed to lower statistical power in Study 2 compared to Study 1. Overall, the findings from the first two studies of this research support the results of previous work suggesting greater difficulties in including students with invisible rather than visible disabilities (Hassard et al., 2024; Mills, 2017; Newheiser & Barreto, 2014; Paetzold et al., 2008).

However, one can argue that directly comparing the two groups of disabilities is not what people spontaneously do and is somewhat artificial. A first solution would be to include a “non-disability condition”, as was done in a Supplementary Study (OSF). Unfortunately, such a paradigm runs into the major challenge of comparing specific categories to a non-category, thus jeopardizing any chance of detecting effects (Aubé et al., 2019). A second solution would be to use a task that avoids explicit group comparisons. Study 3 sought to address this issue through an incidental paradigm by investigating whether (in)visible disabilities elicit distinct spontaneous approach/avoidance reactions towards neutral stimuli.

Study 3

Study 3 aimed to replicate the findings of the first two studies using an approach-avoidance task, the Incidental-VAAST test, that did not require participants to explicitly process the evaluative meaning of disabilities. It has been shown that the incidental presentation (i.e., not explicitly requesting evaluation by individuals) of affective stimuli in VAAST produced compatibility effects and was therefore a way of studying the influence of stimuli on individual’s reactions, by limiting the possible control of response bias (e.g., Pillaud et al., 2023). The underlying idea is that the inducing stimuli will convey their characteristics (e.g., valence) to a neutral target such as a geometric shape and that individuals will react to the neutral target according to the characteristics of the inducing stimuli (e.g., Murphy & Zajonc, 1993; Pillaud & Ric, 2022). This strategy therefore enabled us to replicate our results by limiting the possibility for participants to control their responses and by limiting the comparison between our two categories of stimuli (i.e., visible and invisible disabilities) given that they are not explicitly instructed to jointly evaluate the two types of stimuli in this VAAST.

6.1. Participants and Design

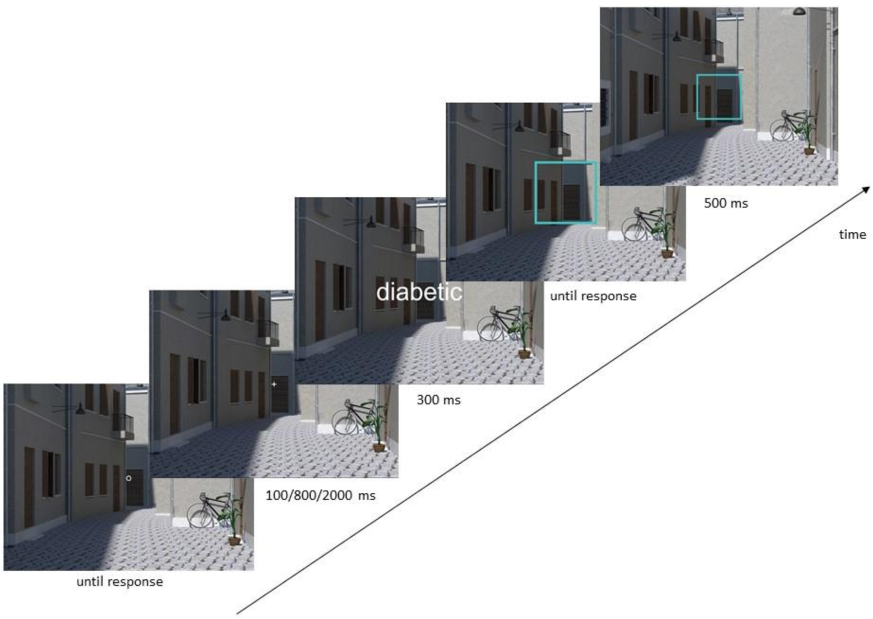
Based on Study 1, we would expect a large effect size (*d* = 0.67). However, as the Incidental-VAAST is a variant of the VAAST that may result in smaller effect sizes due to its even more indirect method of assessing the phenomenon of interest, we therefore cautiously selected an intermediate effect size (*d* = 0.40) with a fixed α -level (.05) and a high statistical power of .90, in order to maximize our chances of detecting any effects. Following this procedure, the required sample size is at least 44 participants in all. To prevent data loss and underestimation of the expected effect size, we recruited 152 French participants (M_{age} = 29.28, SD_{age} = 11.45, 109 women, 39 men, 1 non-binary person, and 1 unspecified) via an online platform (PsyToolKit, Stoet, 2010, 2017) using social media. We used a 2 (visible vs. invisible disability) x 2 (approach vs. avoidance) within-participant design. This sample size provided 80% power to detect an effect size of *d* = 0. 33 or above, with a 5% false-positive rate.

6.2. Materials and Procedure

In Study 3, we used an adapted version of the VAAST that captures more indirect behavioral tendencies (Pillaud & Ric, 2022). This Incidental-VAAST assesses behavioral responses more indirectly, by evaluating to what degree exposure to affective stimuli (here, visible vs. invisible disabilities) can elicit approach/avoidance tendencies in unrelated neutral objects (Pillaud & Ric, 2022). Participants were asked to approach or avoid geometric shapes, specifically a square or a diamond. Disability-related stimuli were presented as primes preceding the targets, and displayed for 300 ms. The use of angular shapes was designed to prevent potential interactions between shapes and affective primes (Palumbo et al., 2015; Pillaud & Ric, 2022). The same 16 stimuli were used as test exemplars, including 8 invisible and 8 visible disabilities, along with the 6 extra words used in the training. Crucially, the disability-related words were presented in a balanced way across all conditions and targets, resulting in one block of 96 test trials (24 trials per each of the four conditions: visible-invisible disability vs. approach-avoidance tendency) preceded by 12 training trials. Other than these modifications, the task was identical to that used in Studies 1 and 2 (see Figure 4). The procedure used in Study 3 was also identical to that used in Studies 1 and 2. Informed consent was obtained from all participants prior to the start of the study. By proceeding to the next page, participants indicated their agreement for their anonymized data to be used for scientific purposes. They were also informed that they could withdraw their data at any time before publication.

Figure 4.

Schematic representation of a VAAST trial where the participant is primed with a stimulus from the invisible disability category and instructed to avoid diamonds (Study 3).



6.3. Results

Data from specific training blocks were excluded from the analysis. Participants with an error rate exceeding 30% were also excluded, resulting in the removal of 1 participant. Like in Studies 1 and 2, only correct responses were analyzed (errors = 3.04% of the data). Based on RT distribution (Ratcliff, 1993), RTs < 300 ms and > 1500 ms were excluded (1.82% of the data). Participants were generally faster in this task than in Studies 1 and 2, likely due to variations in the experimental design, which affected the RT distribution. The data were log transformed to normalize their distribution (Ratcliff, 1993). Other filters and transformations were tested and produced relatively similar results (see supplementary analyses on OSF; Table S8). We also computed the rate of participants and stimuli for which the effect was in the direction of the reported effects (see supplementary analyses on OSF, Table S9). Like for Studies 1 and 2, the data were subjected to a 2 (Movement: approach vs. avoidance) x2 (Category: visible vs. invisible) mixed-model analysis. The estimation of the random effect is detailed in supplementary analyses on OSF (see Table S7).

The analysis did not reveal an effect of the category, $t(153.6) = 0.20$, $p = .84$, 95% CI [-0.012; 0.015], $d_z = 0.03$, but did reveal an effect of the movement, $t(135.2) = 4.36$, $p < .001$, 95% CI [0.020; 0.053], $d_z = 0.36$, where participants approached more rapidly than they avoided the stimuli ($p < .001$, see Table 3 for descriptive analyses). More importantly, the predicted Category x Movement interaction was significant, $t(394.4) = 2.32$, $p = .021$, 95% CI [0.003; 0.034], $d_z = 0.21$ (see Figure 5). The moderation effect was explained in the avoidance condition, wherein participants categorized the neutral items more rapidly when these items were preceded by visible disability stimuli than by invisible ones, $t(170.9) = 1.96$, $p = .052$, 95% CI [-0.018; 0.002], $d_z = 0.16$. No simple effect was observed in the approach condition, $t(302.4) = -1.50$, $p = .13$, 95% CI [-0.035; -0.023], $d_z = 0.12$. Finally, the interaction between category and movement remained significant after controlling for familiarity with disability, $t(827) = 2.53$, $p = .012$, 95% CI [0.004, 0.033], $d_z = -0.20$.

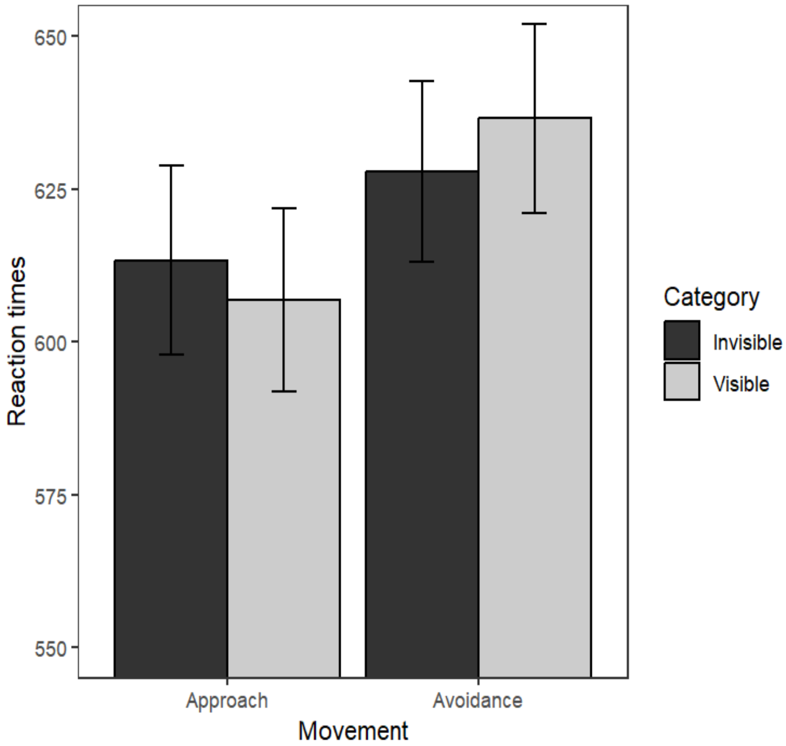
Table 3

*Descriptive mean and standard error response time (in milliseconds) in the VAAST as a function of disability and movement (*N *= 152, Study 3).*

	Visible disability		Invisible disability		*Movement*	
	M	*SE*	*M*	*SE*	*M*	*SE*
Approach	606.81	14.95	613.35	15.41	*610.08*	*15.18*
Avoid	636.53	15.53	627.35	14.79	*632.21*	*15.17*
Disability	*621.69*	*15.29*	*620.63*	*15.11*		

Figure 5.

Means and standard errors of untransformed response time (in milliseconds) as a function of category and movement (Study 3).



6.4. Discussion concerning Study 3

Study 3 provided evidence consistent with Studies 1 and 2, supporting the finding that attitudes are more negative towards invisible disabilities than visible ones. However, the evidence could appear less straightforward, potentially due to a strong overall approach effect. The latter may have overshadowed the weaker effect resulting from our manipulation of visible/invisible disability categories. To understand whether the disabilities' (in)visibility played a moderating role in movement tendencies across the three studies, we conducted two additional analyses: a mini meta-analysis (Goh et al., 2016) and a Bayesian multilevel modeling analysis (Bürkner, 2017).

Complementary Analyses of Studies 1 to 3

7.1. Meta-analytic Approach

We conducted a mini meta-analysis of our three studies (Goh et al., 2016). We first present the effect sizes that were included in the meta-analysis for each study with the 95% confidence interval associated with each d_z (see Table 4).

Table 4.

Presentation of results of the interaction effect in Studies 1, 2, and 3.

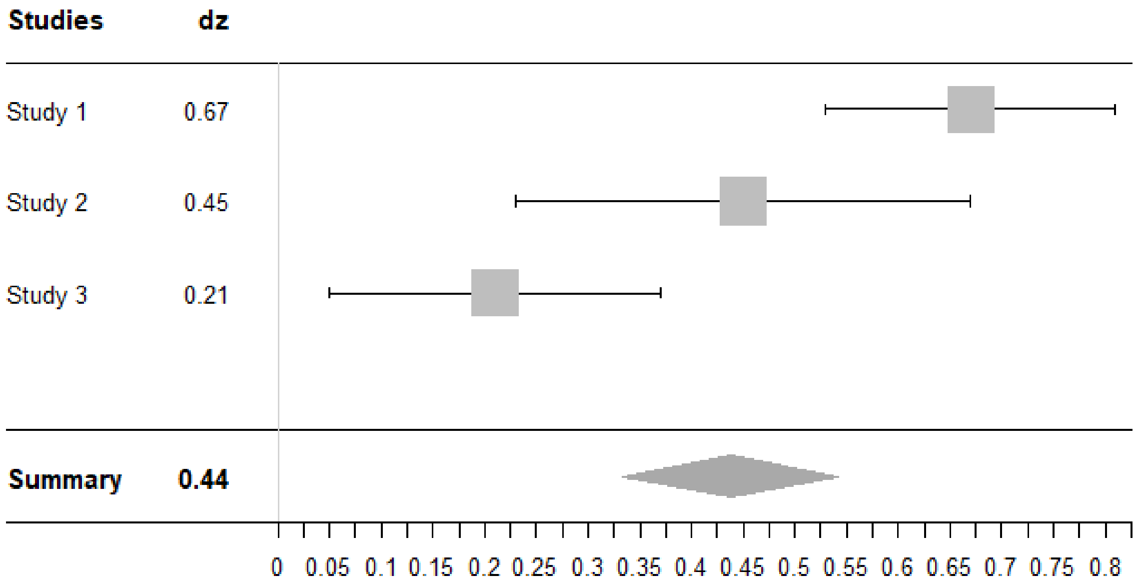
	t	p	d_z	95% CI of d_z	N
Study 1	9.52	< .001	0.67	[0.53; 0.81]	208
Study 2	4.18	< .001	0.45	[0.23; 0.67]	84
Study 3	2.32	.021	0.21	[0.05; 0.37]	152

Since our objective was to conduct a mini-meta-analysis to estimate the effect size across our studies, we chose a fixed-effect meta-analysis (e.g., Borenstein et al., 2021). The fixed effect meta-analysis revealed a significant effect of the hypothesis on the selection of the question in a congruent way, $Md_z = .44$, $Z = 8.23$, $p < .001$, 95%CI [0.33; 0.54], 95%PI [-0.73; 1.61][6] (see Figure 6).

Figure 6.

Forest plot of the studies included in the mini meta-analysis.

[6] 95%PI corresponds to the 95% prediction interval which is an indicator of the effect size of a new study if we select it from among the studies included in this meta-analysis (Borenstein et al., 2021).



7.2. Bayesian Approach

We also conducted a one-sided default Bayes factor hypothesis test to quantify the relative predictive adequacy of the two competing hypotheses: the null hypothesis H0 (i.e., the effect is absent) vs. the alternative hypothesis H1 (i.e., the effect is present). For Study 1, we estimated $BF_{01} \approx 0$, for Study 2, we estimated $BF_{01} = 0.00025$, and for Study 3, we estimated $BF_{01} = 0.054$. These Bayes Factors supported alternative hypothesis H1 (Lee & Wagenmakers, 2014; i.e., $BF_{01} < 0.33$). More precisely, Study 3 provided moderate evidence in favor of H1, and Studies 1 and 2 provided extremely strong evidence in favor of H1. Taken together, the results of fixed-effects meta-analyses as well as the results of the Bayesian analyses supported the hypothesis positing that the category of stimuli moderated the effect of movement in an approach/avoidance task.

7.3. Discussion concerning Complementary Analyses

Complementary analyses across Studies 1 to 3 provided additional support for our findings showing negative attitudes towards invisible disabilities. The meta-analysis revealed a consistent pattern in line with our initial hypothesis and the results of each individual study. The Bayesian analyses also supported these findings, providing evidence for stronger negative attitudes towards invisible disabilities. This consistency across different statistical approaches highlights the robustness of our findings and the reliability of our experimental design.

General discussion

This research aimed to shed new light on socio-cognitive psychological processes within disability research using rigorous experimental paradigms. It examined attitudes that account for the complex nature of disability, that are mainly overlooked in the social psychology literature (Granjon, Rohmer, et al., 2023). These attitudes were measured through spontaneous visual behavioral tendencies, a powerful alternative to traditional indirect measures (e.g., IAT) that align closely with individuals' experiential reality (Rougier et al., 2018). Additionally, this research adheres to the principles of robust science by incorporating replication efforts, diverse inferential analysis types (i.e., frequentist and Bayesian), and a mini meta-analysis. It provides reliable evidence that individuals with invisible disabilities face more negative attitudes than individuals with visible disabilities. The consistent results across all three studies demonstrate that disability moderates behavioral tendencies, a finding confirmed by Bayesian analysis and a mini meta-analysis. Specifically, Study 1 revealed faster avoidance tendencies towards individuals with invisible disabilities, whereas individuals with visible disabilities elicited faster approach tendencies. Study 2 replicated the simple effect of approach, while Study 3 replicated the simple effect of avoidance. Here, we discuss how the key findings of this research contribute to our understanding of intergroup relations, examine the potential explanatory factors behind these findings, consider some societal implications, and outline the limitations of the study along with suggesting directions for future research.

Our findings advance the understanding of socio-psychological mechanisms governing behaviors toward individuals with disabilities, highlighting the critical role of visibility. The visibility of a disability influences a variety of psychological processes, such as stereotyping (Granjon, Rohmer, et al., 2023), stigmatization (James et al., 2018), perceptions of accommodations (Prince, 2017; Santuzzi et al., 2014; Syma, 2019), self-concept (Shpigelman & HaGani, 2019), and group identification (Nario-Redmond et al., 2013). By examining how visibility impacts attitudes toward disability, our study used behavioral tendencies as an indicator of prejudice, defined here as negative intergroup attitudes (Eagly & Diekman, 2005). Prejudice is a powerful predictor of behavior (Fiske & Taylor, 2013; for a recent synthesis, see Nelson & Olson, 2023). The pronounced negative attitudes we observed toward people with invisible disabilities, evidenced by affective-driven avoidance tendencies (Frijda, 2016; Pillaud & Ric, 2022), are a strong indicator of discrimination against this group.

These results suggest that visibility fundamentally alters social responses, placing individuals with invisible disabilities at greater risk of subtle yet pervasive social exclusion (Serpas et al., 2024). Our findings then enrich the psychosocial disability field, which often emphasizes stable categories like race and gender but overlooks the unique role of visibility in shaping social biases (Granjon, Rohmer, et al., 2023). One possible explanation for our results is that the absence of visible markers can lead to suspicion, doubt, and even a denial of legitimacy. This explanation is further supported by studies on ambiguity aversion, which show that the absence of clear, observable markers often amplifies negative attitudes toward invisible disabilities (Smith et al., 2022), while limited media representation fosters unfamiliarity and prejudice, creating a cycle of misunderstanding (Johnson & Lee, 2023). In addition, visibility issues significantly intersect with specific challenges faced by individuals with invisible disabilities, where disclosure often entails navigating social expectations and risks. For example, Hassard et al. (2024) document the difficulty of disclosing non-visible disabilities in educational settings, where the lack of physical indicators complicates requests for accommodations, sometimes leading to stigmatization. This problem is compounded by a limited social understanding of disability, even among the younger generations (Lecomte et al., 2024), which often fails to encompass the nuanced experiences of those with non-visible conditions, reinforcing a narrow and sometimes exclusionary view of disability in educational environments. Together, these studies highlight the urgent need to consider visibility as a moderating factor of ableism.

Moreover, in most studies that aim to measure prejudice through approach and avoidance tendencies, researchers have usually employed the joystick task (Chen & Bargh, 1999). In this task, participants are asked to pull or push a lever to perform approach and avoidance movements. However, this type of measurement has proven unreliable due to the ambiguity of the movements required (e.g., Rougier et al., 2018). Specifically, the same arm flexion movement can be interpreted as an approach action (e.g., Paladino & Castelli, 2008) or as an avoidance action (e.g., Markman & Brendl, 2005). Consequently, interpreting results obtained through such a task can be challenging. By simulating full-body movement through VAAST, we addressed these limitations and revealed intergroup effects using an incidental version of the VAAST. This approach demonstrated the intergroup compatibility effect between visible and invisible disability groups, supporting the value of approach-avoidance tasks in measuring prejudice (Aubé et al., 2019; Rougier et al., 2020).

Interestingly, discrepancies emerged between tasks. In Study 3, using the Incidental-VAAST, we observed a preference for visible disabilities but no significant negative bias towards invisible disabilities. Participants exhibited a stronger inclination for both types of disabilities, evidenced by faster approach reaction times compared to avoidance. These findings contradict those of other studies that have shown disability to be more closely associated with negative valence (Antonak & Livneh, 2000; Dovidio et al., 2011; Wilson & Scior, 2014), suggesting an overall inclination towards avoidance movements. On the other hand, they align with prior research indicating a general tendency toward approach in 'approach-avoidance tasks' (Alexopoulos & Ric, 2007). Therefore, the incidental design of Study 3 may have obscured the differences between visible and invisible disabilities, thereby allowing the overall preference for approach tendencies to overshadow them. Further replications should provide valuable insights into the robustness of this effect.

In addition, the specific characteristics of the category of disability help explain the mechanisms behind these heightened negative attitudes. On the one hand, the permeability of intergroup boundaries plays a specific role. Unlike skin color or gender, anyone can acquire a disability, making it a category that elicits fear (Rohmer et al., 2000). This challenge is greater for invisible disabilities, as individuals with these disabilities resemble "able" individuals but require accommodations (Nario-Redmond et al., 2013). On the other hand, the category of invisible disabilities is less accessible in memory, exhibits greater heterogeneity, receives less media representation, and does not align with the prototypical representation of disability (e.g., a wheelchair, Fritsch, 2013; Rohmer & Louvet, 2012). Consequently, the mere exposure effect suggests a greater inclination to approach prototypical types of disability (visible ones, Jones et al., 2010). This is supported by Studies 1 and 2, which show that invisible disabilities are categorized more slowly than visible ones, showing they are less easily accessible in memory. However, overall response times in Studies 1 and 2 were longer than in other studies, potentially due to the difficulty in processing the words used. Study 3, in which the Incidental-VAAST was used, demonstrated shorter reaction times, consistent with previous research. Participants in Studies 1 and 2 might have attempted to regulate their responses, formalizing normative protection primarily for visible disabilities. Further research is necessary to investigate the extent to which avoidance tendencies toward people with invisible disabilities can be accounted for by cognitive or motivational effects.

Our findings also have societal implications, underscoring how the visibility of the disability influences real-world settings. In France, disability remains a primary reason for appeals to the Defender of Rights, with individuals with invisible disabilities accounting for the majority of claimants (Kelly & Mutebi, 2023). Disability has emerged as a pivotal factor in shaping social evaluations, often surpassing other characteristics such as gender or ethnicity (Rohmer & Louvet, 2009). By recognizing disability as a superordinate social category, our results highlight how (in)visibility further moderates social assessments tied to societal issues (Granjon, Rohmer, et al., 2023). In line with prior field studies, our findings suggest that invisible disabilities provoke greater prejudice, often translating into lower social inclusion rates (Newheiser & Barreto, 2014; Paetzold et al., 2008). For example, Mills (2017) found that individuals with invisible disabilities requiring service dogs reported more discrimination and legitimacy challenges than those with visible disabilities. Converging evidence from inclusive education literature, as seen in Study 2’s focus on teachers, further reinforces these findings.

Several caveats should be noted. Firstly, we did not measure the tangible extent of social inclusion of individuals with (in)visible disabilities. This omission represents a missed opportunity to gain valuable insights into the alignment between what we captured through the present attitude measures and real-world settings. This underscores the need for a comprehensive examination of broader contextual factors to draw relevant conclusions across various fields in psychology. Secondly, our use of a simulated scenario may have missed confounding factors typically elicited in real-life interactions. Direct interactions with known individuals can introduce additional factors that shape attitudes and biases through interpersonal nuances and emotional responses (Zajonc, 1968), which our study design was not intended to capture. Research on intergroup contact suggests that meaningful changes in attitude often require sustained or reciprocal interactions (Allport, 1954), elements that were beyond the scope of the present study. Future research could expand on our findings by exploring how real-life, direct interactions might differently impact attitudes toward individuals with invisible disabilities. Thirdly, one could question the extent to which the relevance of our results hinges on the timing of disclosure of an invisible disability – whether it precedes or follows the initial encounter and acquaintance with the individual. Indeed, the disclosure of a disability presents unique challenges that individuals with a visible disability do not face, including recurring questions about when, how and to whom to disclose (Lyons et al., 2017; Ragins et al., 2007). The temporal sequence of events related to invisible disabilities, which might sometimes involve the initial acquaintance with the person, gathering cues about their individual characteristics, and subsequently activating the disability category, introduces a degree of complexity that requires careful consideration when interpreting our findings. Indeed, we highlighted the disability categories without providing any personal information. Therefore, a more comprehensive exploration of the intricate dynamics surrounding the timing of disclosure and its impact on attitudes toward individuals with invisible disabilities becomes a crucial avenue for further research in the broader field of intergroup relations and attitudes.

Conclusions

This research contributes to the expanding body of literature that acknowledges the heterogeneity of disabilities, with a specific focus on the often-underrepresented population of individuals with invisible disabilities. Rooted in field studies that center on experimental-based models, our hypothesis emerges from this empirical foundation, challenging the limitations of traditional psychosocial models, which often fall short in capturing the complexities and nuances of people with disabilities. Mostly viewed as a homogeneous group, people with disabilities experience diverse social realities that are not adequately addressed by current theories. Consequently, our approach is *a fortiori* data-driven, designed to gain insights that might otherwise be overlooked. By prioritizing the voices and realities of those with disabilities, we aim not only to expand the scope of current theoretical models in disability and social psychology but also to inspire a more inclusive and comprehensive understanding within the field.

CRediT Taxonomy

MG conceptualized, curated data, conducted formal analysis and investigation, developed the methodology, and wrote the original draft. NP curated data, conducted formal analysis, developed the methodology, and contributed to writing the original draft. MPR conceptualized the study, secured funding, managed the project, and contributed to its revision. BA conceptualized and contributed to writing the review and editing. OR conceptualized, secured funding, managed the project, and contributed to its revision.

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