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Exploring "fringe" consciousness: The subjective experience of perceptual fluency and its objective bases☆

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Abstract

Perceptual fluency is the subjective experience of ease with which an incoming stimulus is processed. Although perceptual fluency is assessed by speed of processing, it remains unclear how objective speed is related to subjective experiences of fluency. We present evidence that speed at different stages of the perceptual process contributes to perceptual fluency. In an experiment, figure-ground contrast influenced detection of briefly presented words, but not their identification at longer exposure durations. Conversely, font in which the word was written influenced identification, but not detection. Both contrast and font influenced subjective fluency. These findings suggest that speed of processing at different stages condensed into a unified subjective experience of perceptual fluency.

1. Introduction

If scholars discuss consciousness, they often mean conscious representation of materials that are at the focus of attention. It is consciousness about something. However, some experiences are at the periphery of the stream of consciousness. James (1890) introduced the term "fringe consciousness" to denote vague feelings that provide contextual information about conscious materials that are in the focus of attention (see Cook, 1999; Mangan, 1993; Velmans, 2000, for

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discussions). This information comes in a highly condensed form. As Baars and McGovern (1996) and Epstein (2000) pointed out, the fringe, as introduced by James, refers to several kinds of feelings. Examples are familiarity; the tip-of-the-tongue state (see Brown, 2000); feelings of knowing (see Koriat, 2000); the sense of being on the right track (see Mangan, 1993).

In this article, we discuss one kind of phenomenal experience at the fringe of consciousness: Perceptual fluency (see Reber, Fazendeiro, & Winkielman, 2002). This is the subjective experience of ease with which a person can process incoming information. Perceptual fluency accompanies every perceptual act and is felt at the periphery of conscious awareness. This feeling is not at the focus of attention unless one assesses it directly. Therefore, it is on the fringe of consciousness most of the time.[1] Fluency may or may not be reflected in conscious subjective experience (see Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Thus, we use the term *objective* fluency to refer to the dimension of speed, resource demands, and accuracy of mental processes. High objective fluency involves high speed, low resource demands, high accuracy, or other indicators of efficient processing, without necessarily assuming that these processes are reflected on a subjective level. On the other hand, we use the term *subjective* fluency, to refer to a conscious experience of processing ease or difficulty, effort, speed, etc. High subjective fluency is characterized by the feeling of ease of ongoing processing, low effort, or high speed.

Fluency can reflect processes and manipulations occurring at various levels (see Winkielman et al., 2003). *Perceptual* fluency reflects the ease of low-level processes concerned primarily with stimulus form. Accordingly, perceptual fluency is influenced by variables like repetition, perceptual priming, clarification, presentation duration, or figure-to-ground contrast (see Reber et al., 2002). On the other hand, conceptual fluency reflects the ease of high-level processes concerned primarily with stimulus meaning and its relation to other semantic knowledge structures. Accordingly, *conceptual* fluency is influenced by variables like semantic priming or semantic predictability, etc. (e.g., Whittlesea, 1993). Research suggests that in many cases the effects of various processing manipulations tend to result in a similar feeling of general "fluency." In this article, we will focus on origins of perceptual fluency; if we use the term "fluency," we always mean "perceptual fluency."

We first provide an overview on research about effects of perceptual fluency in judgmental tasks. We then turn to the assessment of perceptual fluency: Although it is often defined as a phenomenal experience, it is normally measured in terms of objective perceptual speed, which is assumed to reflect the feeling. Are perceptual speed and subjective experience of fluency just two sides of the same coin, as suggested by the assessment of perceptual fluency in psychological research? We show that the relationship between objective and subjective perceptual fluency is more complicated: we present evidence that subjective fluency is a feeling based on objective perceptual fluency at different stages of perceptual processing. Subjective perceptual fluency is a unified experience based on objective fluency from several sources.

[1] According to Galin (2000), the distinction between nucleus and fringe is not determined by the distinction between focus of attention and periphery. For him, nucleus and fringe elements of a stimulus are constant, and the proportion of nucleus and fringe parts that is in the focus of attention varies. Perceptual fluency, according to Galin's terminology, would always be part of fringe consciousness, with visual features of the stimulus at the nucleus. However, regardless of the kind of distinction between nucleus and fringe one endorses, it seems justified to describe perceptual fluency as an experience on the fringe of consciousness.

2. Effects of perceptual fluency in judgmental tasks

Several lines of research have demonstrated that people draw on the subjective experience of fluency to make a variety of judgments. Repeated exposure has been shown to have an impact on a multitude of experiences and judgments, such as processing fluency (Whittlesea, Jacoby, & Girard, 1990), perceived duration of stimulus exposure (Witherspoon & Allan, 1985), familiarity (Whittlesea, 1993), fame (Jacoby, Kelley, Brown, & Jasechko, 1989), affect (Bornstein, 1989; Kunst-Wilson & Zajonc, 1980; Zajonc, 1968), and perceived truth of a statement (e.g., Begg, Anas, & Farinacci, 1992; Hasher, Goldstein, & Toppino, 1977). These findings led to the idea that repeated exposure results in higher processing fluency that, in turn, has an impact on judgments. Whittlesea et al. (1990), for example, presented seven words in rapid succession. Then, a target word was shown that was either presented before (“old”) or not presented (“new”). Orthogonally crossed to the repetition condition, the degree of blurring of the target word was manipulated. Participants had to judge whether the target word was presented before or not. Old words were more likely to be judged as old than new words. More importantly, the degree of blurring influenced judgments: less blurring resulted in higher likelihood of “old”-judgments. This finding suggests an effect of processing fluency on familiarity, resulting in higher probability to judge a target word as old. Using a similar experimental paradigm, Whittlesea (1993) was able to replicate and extend the findings on fluency and familiarity. Moreover, he manipulated repetition factors and conceptual fluency and showed that both repeated exposure and conceptual fluency resulted in enhanced pleasantness.

Reber, Winkielman, and Schwarz (1998) manipulated perceptual fluency by varying the presentation duration of simple shapes in a single exposure paradigm. As expected, shapes shown for a longer duration (e.g., 400 ms) were liked more, and disliked less, than shapes shown for a short duration (e.g., 100 ms). The most direct support for the role of perceptual fluency in affective judgment comes from research that manipulated ease of processing through subliminal priming procedures. Specifically, Reber et al. (1998) presented a prime that facilitated or inhibited processing of the target picture. As predicted, the same targets were judged as more beautiful when preceded by a matching rather than non-matching prime. Recently, Winkielman and Cacioppo (2001) replicated the self-report findings of Reber et al. (1998) and demonstrated that perceptual fluency increased activity over the region of the zygomaticus major, indicating that the resulting affect was more positive. This finding suggested that fluency effects on liking were not merely due to judgmental biases.

Recently, other single exposure studies found fluency effects on non-affective judgments. Processing fluency has been shown to influence classifications in a grammar learning task (Whittlesea & Leboe, 2000), frequency estimates (Reber & Zupanek, 2002; Wänke, Schwarz, & Bless, 1995), feelings of knowing (see Koriat, 2000), and judgments of truth (Reber & Schwarz, 1999).

3. Perceptual fluency: Subjective experience and its objective bases

Perceptual fluency was assessed by measures like pronunciation latency (e.g., Whittlesea, 1993; Whittlesea et al., 1990; Whittlesea & Leboe, 2000; Whittlesea & Williams, 1998, 2000, 2001), likelihood of identification (Jacoby & Dallas, 1981), or naming latency (Reber et al., 1998).

All these assessments of perceptual fluency were based on the simple assumption that objective perceptual speed or accuracy underlies the subjective experience of perceptual fluency. Is this simple assumption justified? More specifically: Is there a one-to-one mapping of objective fluency to subjective fluency? In order to answer this question, we have to ask first what is meant by objective perceptual fluency; we then turn to a discussion of possible mappings between objective fluency and its subjective experience; and finally, we discuss methodological implications of these possible mappings.

3.1. What is objective perceptual fluency?

People looking at a barely visible object may be confronted with at least three problems (see Coren, Ward, & Enns, 1994): first, they have to answer the question: "Is there anything there?" This is the problem of *detection*. Second, after being sure that there is something there, the question arises: "What is it?" This is the problem of *identification*. Third, people may see two objects of the same kind. They may wonder: "Is this object different from that one?" This is the problem of *discrimination*.

The solution to each of these problems needs time. Let us illustrate this point with a mental rotation task (see Shepard & Cooper, 1982): Participants are presented a digit or a letter, e.g., the letter "R" in its normal or in its mirror form. The letter is rotated in clockwise direction to various degrees from the upright position, for example 30°, 60°, 90°, 120°, 150°, and 180°. The task of the participants is to indicate whether the letter is in its normal form or in mirror form. This is a typical discrimination task: Participants have to discriminate between the normal and mirror forms of digits or letters.

Normally, detection is a necessary precondition for identification or discrimination.[2] Therefore, the mental rotation task may be decomposed into two steps: First, the stimulus must be detected; this is no problem in most experiments on mental rotation. Second, it must be discriminated from the reference stimulus (the upright "R"). Experimental evidence suggests that rendering detection more difficult by occluding the letter did not affect the increase in reaction time with increasing angle: The time increase was the same for fully visible and for occluded letters (Schroiff, 1988). However, overall reaction times were longer for occluded than for fully visible letters. The author concluded that solving the mental rotation task included two independent steps: first, the letter has to be clearly seen; then, the letter is rotated in order to perform the discrimination task (see Jolicoeur & Cavanagh, 1992). Completing the mental rotation task involves completing at least two separate component processes, stimulus detection and stimulus discrimination, each of which takes time.

Analogously to the mental rotation example, there seemingly is no single objective fluency. There are stages of the perceptual process, and perception at each stage takes time. We define stage in a functional way, such as detection, which happens early in the perceptual process, or identification and discrimination of a stimulus. Moreover, we test the notion that independent processing components influence each stage, although the processing results of one stage may be

[2] We leave aside instances of unconscious perception where semantic discrimination can be shown in the absence of detection (e.g., Greenwald, Draine, & Abrams, 1996; Marcel, 1983; see Merikle & Daneman, 1998; Reber & Perrig, 2001, for overviews). For the present purposes, there is no incremental utility in discussing unconscious perception.

used for processing at the next stage. We use here the distinction between an early stage that is related to detection and a subsequent later stage that is related to identification in order to illustrate that both stages have their own objective fluency. As the reader will see, we chose detection versus identification because they allow separating empirically the contributions of figure-ground contrast and font to perceptual fluency. However, there are many alternative—and more sophisticated—ways to decompose the process from sensation in peripheral units to perception in the central nervous system (see Jolicoeur & Cavanagh, 1992). Each stage has its own objective fluency. It is an empirical question whether or not these fluencies are independent of each other. For the sake of simplicity, we will discuss only the detection–identification distinction.

3.2. Possible mappings between speed measures and subjective experience

Let us assume that a person has to identify a stimulus in a psychological experiment. She has to read a word as fast as possible. As we have discussed above, there may be no single speed that characterizes this task; there may be both a detection speed and an identification speed.[3] If we assume that there is only one kind of phenomenal experience of perceptual fluency[4]: How do these measures of objective fluency relate to subjective fluency? There are at least three possibilities.

First, detection and identification may be highly related so that one can measure detection speed and draw conclusions about identification speed, or vice versa. In this case, decomposition of perceptual speed does not make sense and perceptual speed could be related to the subjective experience of perceptual fluency. This one-to-one mapping of perceptual speed and the subjective experience of perceptual fluency is the implicit theoretical assumption that underlies the common practice of assessing perceptual fluency in cognitive psychology. However, this possibility does not seem plausible in the light of current knowledge about the perceptual process (see Jolicoeur & Cavanagh, 1992). If it were normal that detection speed and speed at later stages of the perceptual process are highly related, then mental rotation would be an exception to the rule.

There is a second possibility: The phenomenal experience of perceptual fluency may be related to one stage, but not to another. In our example, people may experience higher ease of perception with increasing detection speed, but not with higher identification speed. There would be a one-to-one mapping to the speed of one of the stages of the perceptual process, but not to all stages. There is some anecdotal evidence that both speed at an early stage and speed at a later stage of the perceptual process may contribute to subjective fluency. For example, the better people can detect that something is out there (e.g., a moving animal at night; a masked stimulus on a computer screen), the more they would presumably report that the object is easy to see. This is an example of how speed at an early stage may contribute to subjective fluency. On the other hand, when people who read a newspaper in the evening have difficulties to distinguish the letter "K" from the

[3] For the sake of simplicity, we refer to the speed related to the early perceptual stage that is assessed by detection performance as *detection speed* and to the later stage assessed by identification performance as *identification speed*, without implying that detection alone or identification alone determines these speed measures. It does neither imply that detection processes or identification processes have to be causally related to fluency.

[4] There has actually been no discussion in the literature about different qualities of the phenomenal experience of perceptual fluency. Our assumption—that there is only one kind of this experience—corresponds to ongoing theorizing in cognitive psychology.

letter "R", they turn on the light. This seems to be a problem of speed at a later stage in the perceptual process. Such examples from everyday life suggest that speed at more than one stage of the perceptual process may contribute to the feeling of perceptual fluency.

This leads to the third possibility: Detection speed and identification speed may be independent, but the subjective experience of perceptual fluency is related to both. Objective fluency at a given moment might translate into a minute experience of fluency, adding up to an overall impression of ease with which a stimulus can be perceived. Hence, subjective fluency at the periphery of the stream of thought is made up of minute experiences of speed of processing that accompany conscious experience at the focus of attention.

3.3. Methodological implications

What are the methodological implications of each of the three possible mappings? First, there is no problem if performances in different perceptual stages are related: Researchers may employ the normally used assessments of objective fluency that perfectly reflect the subjective experience of perceptual fluency. Second, problems may arise if the experience of fluency depends on some, but not on another stage. The assessment of fluency may yield a result that suggests that there is no difference in the experience of fluency where there actually is one. This would be the case if researchers used an assessment that includes the stage that is not related to subjective fluency. If subjective fluency is due to speed at a very early perceptual stage that could be captured by detection performance only, but a researcher uses an identification task, he or she may get a null result and erroneously conclude that there is no experience of fluency. Third, a similar problem arises with the many-to-one mapping: If speeds of several stages contribute jointly to subjective fluency, one cannot be sure to have assessed the right stage. One may erroneously conclude that the stimuli do not differ in perceptual fluency because one has employed an inadequate task.

In sum, researchers may miss existing differences in perceptual fluency if unrelated stages of the perceptual process make independent contributions to the phenomenal experience of fluency and arrive at erroneous conclusions. To address the relationship between objective and subjective fluency, we performed an experiment in that we used a detection task to assess an early stage of the perceptual process and an identification task in order to assess a later stage in the perceptual process.

4. Objective and subjective fluency: An experiment

We examined how two different dimensions—figure-ground contrast and font of written words—influenced two stages of the perceptual process: Detection and identification. We discussed three possibilities how subjective perceptual fluency may be related to objective perceptual fluency. Let us go through the three possibilities and let us see what our study would predict for each of these possibilities.

(a) If performance in the detection and identification tasks were highly interrelated, we would observe that both contrast and font influence subjective fluency and both measures of objective fluency—detection performance and identification performance. (b) If performance at one, but not another perceptual stage were related to subjective perceptual fluency, we would observe that either contrast or font are related to subjective fluency, but not both of them. Let us assume that subjective perceptual fluency is related to identification, but not to detection. If both contrast and font increased performance in the identification task, the subjective experience of fluency should be related to both. However, there is good reason to expect that processing of contrast happens at a sensory level (see Olzak & Thomas, 1986) whereas identification needs processing at a more cognitive level (see Kintsch, 1998). Therefore, we expect that font, but only marginally contrast is related to identification performance. If so, font only should be related to subjective fluency. (c) Finally, detection and identification may be related to independent stages of the perceptual process that both contribute independently to subjective perceptual fluency. In this case, contrast and font would jointly contribute to subjective fluency but not to the measures of objective fluency.

One group got a detection task that was a presence-or-absence judgment. Another group was given an identification task; participants in this condition had to press a button as soon as they identified the word and then had to name it; this kind of assessment of fluency is one used in research on familiarity effects (e.g., Whittlesea et al., 1990). A third group had to give ratings of subjective ease with which the stimuli could be processed. We used identical word lists in all three conditions, which were manipulated in a between-subjects design because we would expect that stimulus repetition in a within-subjects design might influence detection, identification (e.g., Jacoby & Dallas, 1981), and subjective experience (e.g., Haber & Hershenson, 1965). For example, if a participant first solves the detection task and then gives subjective fluency ratings for the same stimuli, his or her ratings may be influenced by the former experience of a stimulus' detectability. Therefore, each participant saw each stimulus only once.

4.1. Methods

4.1.1. Participants

Forty-eight undergraduate students participated in the experiment for course credit. They were assigned randomly to one of the tasks; There were 16 participants each in the detection task, the identification task, or the subjective fluency task, respectively. All reported normal or corrected-to-normal vision.

4.1.2. Materials

The experiment was programmed with Psyscope (Cohen, MacWhinney, Flatt, & Provost, 1993) on a PowerMacintosh 7600/132, using a 17 in. color monitor. A button box that provided precise timing recorded the participants' responses.

The stimuli used in this experiment were 96 German nouns with length ranging from three to eight letters.

Figure-ground contrast and font were assigned randomly to the word items. Figure-ground contrast on a white background was high for half of the words and low for the other half. Words with high figure-ground contrast were 70% black on the CMYK-scale; words with low figure-ground contrast were 30% black on the same scale. The words were about 7 mm high and between 15 and 35 mm wide. Fonts used were Times and TremorITC TT (or, in short, Tremor), which has a less regular typeface than Times and therefore is less readable. Stimuli were masked with a computer-generated random pattern mask—with 75% black pixels and 25% white pixels—that was about 9 mm high and 43 mm wide, and thus covered the surface of the words.

4.1.3. Procedure

Participants were seated at a distance of approximately 70 cm from the screen. Participants in the detection and identification conditions responded by pressing buttons on the button box. Their choices and response latencies were recorded. Participants of the subjective fluency condition entered their ratings on the computer keyboard. The experiment began with the instruction that was presented on the screen, followed by a practice phase consisting of eight trials. When the participant had no questions, he or she could start with the experimental trials by pressing a button on the button box (detection and identification tasks) or the space bar (subjective fluency task).

Detection. First, a black fixation cross appeared on white background for 500 ms in order to focus the participant's attention on the center of the screen. A pattern mask with a frame was shown for 1000 ms, followed by the target stimulus presented for 16 ms in 50% of the cases or a blank frame in the other 50%. A computer-generated random pattern mask immediately followed the stimulus. This mask had the same parameters as the mask shown before onset of the stimulus and remained on the screen until the participant pressed a response-key. Pre- and postmask as well as the target stimulus, respectively the blank field, were surrounded by a 1 mm black frame. In the cases without target item, only the frame was on the screen for 16 ms. The frame made detection of the stimuli more difficult. Pilot testing showed that without frame, detection of the stimuli would have been too easy.

Participants had to decide whether or not a target-stimulus was shown between the two masks. They were told to react as spontaneously as possible, and to guess if they did not know whether the target was present or absent.

Identification. First, a black fixation cross appeared on white background for either 500, 1000, or 1500 ms, followed by the target stimulus. We used different onsets for the stimuli in order to prevent temporal regularity in performing the task; pilot testing showed that participants followed a rhythm when the fixation cross had a fixed duration. The participant had to press a key as soon as he or she identified the word. After the key press, participants had to name the stimulus aloud. The stimuli remained on the screen until the participant pressed the button on the button box and were then masked by a pattern mask.

Subjective fluency ratings. After the instruction, the participants saw the 96 written words on the computer screen, one by one, preceded by a black fixation cross. They had to rate on a nine-point scale, ranging from 1 (badly readable) to 9 (well readable), how easy the words were to perceive.

4.2. Results

Results are presented in three subsections: we first present analyses for the subjective fluency rating, then for the detection task and finally for the identification task. Beyond the usual statistics, we report effect size r for main effects (see Rosenthal, Rosnow, & Rubin, 2000) in order to show that there is a double dissociation in terms of effect size.

Subjective fluency rating. Data for the subjective fluency ratings are shown in Table 1. A 2×2-factorial analysis of variance with both factors manipulated within subjects yielded significant main effects of contrast, $F(1,15) = 68.87$, $p < .001$, $MSE = .34$, $r = .91$, and of font, $F(1,15) = 88.45$, $p < .001$, $MSE = 1.63$, $r = .92$, and a significant interaction between contrast and font, $F(1,15) = 8.89$, $p = .009$, $MSE = .31$. As expected, words presented with high contrast

Table 1
Means and standard deviations for ratings of subjective fluency by figure-ground contrast and font

	Times	Tremor
Contrast high	8.32 (.66)	4.90 (1.86)
Contrast low	6.70 (1.31)	4.11 (1.77)

got higher ratings than words with low contrast, and words written in Times got higher ratings than words written in Tremor. The interaction did not qualify these main effects, but was due to higher effect size for the difference between high and low contrast when font was Times, $t(15) = 6.557$, $p < .001$, $r = .86$, rather than Tremor, $t(15) = 5.658$, $p < .001$, $r = .82$.

Detection. Data for reaction times in the detection task are shown in the upper half of Table 2. We performed a 2×2-factorial analysis of variance. The two factors, contrast and font, were manipulated within subjects. The analysis yielded a significant main effect of contrast, $F(1,15) = 21.23$, $p < .001$, $MSE = 10965.32$, $r = .77$, and a marginally significant effect for font, $F(1,15) = 3.65$, $p = .075$, $MSE = 3671.93$, $r = .44$. Reaction times were faster for stimuli with high figure-ground contrast and somewhat faster for stimuli written in Times rather than Tremor. The interaction effect was not significant, $F(1,15) = .92$, $MSE = 3592.32$.

Data for errors in the detection task are shown in the lower half of Table 2. A 2×2-factorial analysis of variance with the same factors yielded a highly significant effect of contrast, $F(1,15) = 1394.16$, $p < .001$, $MSE = 5.67$, $r = .99$. There were far more errors for stimuli with low contrast than for stimuli with high contrast. There were more errors for words written in Tremor than for words written in Times, but neither this main effect nor the interaction effect were significant, $F(1,15) = 2.24$, $MSE = .57$, $r = .36$, and $F(1,15) = .02$, $MSE = .65$, respectively.

Identification. Data for reaction times in the identification task are shown in the upper half of Table 3. We performed 2×2-factorial analyses of variance, with the two factors, contrast and font, manipulated within subjects. This analysis yielded a significant effect of font, $F(1,15) = 10.22$, $p = .006$, $MSE = 2430.67$, $r = .64$. Speed for stimuli written in times was higher than speed for stimuli written in tremor. Speed for stimuli with high contrast to the background was somewhat faster than for stimuli with low contrast, but this difference was not

Table 2
Means and standard deviations for reaction times (ms) and errors in the detection task by figure-ground contrast and font

	Times	Tremor	No shape
Reaction times			
Contrast high	572 (136)	616 (172)	
Contrast low	707 (198)	722 (217)	
No shape			717 (201)
Errors			
Contrast high	.31 (.70)	.63 (.72)	
Contrast low	22.56 (2.68)	22.81 (2.23)	
No shape			.94 (.93)

Table 3
Means and standard deviations for reaction times (ms) in the identification task by figure-ground contrast and font

	Times	Tremor
Reaction times		
Contrast high	398 (95)	430 (139)
Contrast low	402 (96)	448 (141)
Errors		
Contrast high	.00 (.00)	.63 (1.31)
Contrast low	.06 (.25)	.44 (.63)

significant, $F(1,15) = 2.05$, $MSE = 878.21$, $r = .35$. The interaction was not significant, $F(1,15) = .49$, $MSE = 1594.36$.

Data for errors in the identification task are shown in the lower half of Table 3. The 2×2-factorial analyses of variance, both factors manipulated within subjects, yielded a significant effect of font, $F(1,15) = 13.33$, $p = .002$, $MSE = .30$, $r = .69$. Words written in Times resulted in fewer errors in identification than words written in Tremor. Neither the effect of contrast nor the interaction effect were significant, $F(1,15) = .27$, $MSE = .23$, $r = .13$, and $F(1,15) = 1.67$, $MSE = .15$.

4.3. Discussion

Participants who had to rate the subjective ease of perception were influenced by contrast and by font. Words with high contrast were subjectively more fluent than words with low contrast; words written in Times were experienced as more fluent than words written in Tremor. Subjective fluency did not, however, reflect detection performance or identification performance alone. We found a double dissociation between the two tasks: Contrast had a high impact on both detection accuracy and detection speed; font had only a slight influence on detection errors, and only a marginal influence on detection speed. Even at this early stage of the perceptual process, font may have a slight influence on speed with which a word is perceived. Font, but not contrast, had a significant influence on identification speed and accuracy; In terms of effect size, font had a much higher impact on identification speed than contrast. It may be surprising that contrast did not have a more pronounced influence on identification performance. This finding seemingly contradicts our notion of perceptual stages, one tied to detection, the other tied to identification. However, detection is not time consuming, it normally takes a few milliseconds. Therefore, the differences between high and low contrast in the identification task are expected to be small and insignificant. Moreover, our finding does not mean that contrast never influences identification performance; one can well imagine that very low figure-ground contrast would have hampered identification performance; this was not the case in this study because even the low contrast stimuli were clearly visible.

With the detection and identification tasks, we separated two perceptual stages, as indicated by the double dissociation between the two tasks. We have shown that these two separate perceptual stages—one related to detection performance, the other related to identification performance—contribute jointly to the subjective experience of fluency.

In the introduction, we discussed three possibilities how objective fluency may be related to perceptual fluency. First, objective fluency of different perceptual stages may be intimately related so that detection speed would predict identification speed. We can exclude this first possibility: detection performance was not related to identification performance, as shown by the double dissociation between the two tasks. Second, subjective fluency may be related to one perceptual stage, but not to another. This was neither the case in our experiment, as subjective fluency was related both to detection performance and identification performance. However, it is still possible that there are other perceptual stages or perceptual components whose objective fluency is not related to the subjective experience of fluency (see Poldrack & Logan, 1997). It will be a challenge for future research to find such stages or components. Finally, we argued that perceptual stages might be independent, but that objective fluency of each stage contributes to the phenomenal experience of fluency. That is exactly what we have found in our study: Detection performance and identification performance were independent, but both were related to subjective perceptual fluency. Therefore, objective fluency, as measured with common perceptual tasks, and subjective fluency do not represent two sides of the same coin. There is a many-to-one mapping: Speeds of subsequent perceptual stages determine the subjective experience of fluency. Objective fluency of independent stages seemingly contributed independently to the phenomenal experience of fluency. In sum, the most plausible account for our findings is that objective fluency at each stage of the perceptual process translates into minute experiences of subjective fluency.

Using the process dissociation procedure by Jacoby (1991), Poldrack and Logan (1997) found that speed explained only a small fraction of the fluency in recognition. They divided the entire RT into a perceptual stage and a decision stage and concluded that fluency relevant for recognition judgments may be based on fluency in the perceptual stage. At first sight, this view seems to be incompatible with our findings, but the contradiction is more apparent than real: They partitioned the recognition process into a perceptual stage and into a decision stage; however, the two stages can be partitioned further. For example, it is well possible that there are two perceptual stages, an early and a later one, and speeds of both stages contribute to fluency in the perceptual stage, whereas the speed in the decision process may be unrelated to fluency in the recognition process. We were interested in a decomposition of the perceptual stage into two stages: one assessed by detection and a later one assessed by identification.

What are the methodological implications of our findings? If perceptual fluency is assessed by objective fluency of perception and one finds an effect of a certain perceptual feature on speed or accuracy, there seems to be no problem. Therefore, there is no problem with published research on effects of perceptual fluency, as assessed by objective measures, on different judgments. It is more problematic if someone finds an effect of a perceptual feature on some judgment but not on objective processing fluency. For example, experimenters may be interested in how perceptual fluency, manipulated by figure-ground contrast, influences liking. If the experimenters used an identification task to assess (objective) perceptual fluency, they would probably find that contrast does not have a significant effect on perceptual speed. In this case, they may conclude that it is not perceptual fluency that does mediate the effect of contrast on liking. Our findings suggest that an absence of a significant effect of a feature on a measure of objective fluency, such as a perceptual speed measure, does not necessarily mean that this feature does not influence the phenomenal experience of perceptual fluency. It is not sufficient if experimenters present data on objective fluency to support the claim that they have found an effect of a perceptual feature on a judgmental task that is not mediated by perceptual fluency. We suggest that they should provide additional evidence for this claim by showing that the perceptual feature under consideration does not influence subjective ratings of ease of perception (see Jack & Shallice, 2001, for a similar position).

By mapping subjective experience to its objective bases, we may learn something about the nature of conscious experience.[5] If our findings can be replicated with different tasks and in different modalities, this would suggest that objective fluency at different stages of the perceptual process condense into one and the same contextual feeling of fluency. Similarly, other cognitive processes at different processing stages may condense into one and the same phenomenal experience. It is premature to discuss whether or not the feeling of rightness discussed by Mangan (1993) is related to the experience of perceptual fluency. However, as already discussed by Mangan, the feeling of rightness may by a condensation of different cognitive processes, in the same way as perceptual fluency is a condensation of objective fluency at different perceptual stages. In sum, it may turn out that subjective experience represents objective processes in a highly condensed form.

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[5] The distinction between subjective experiences and their objective bases seems to imply some form of dualism. This is not our intention. Subjective experience may be a brain process itself (see Searle, 1992).

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