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Measuring the Frequency of Inner-Experience Characteristics

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Abstract
Inner experience is widely accepted by psychologists and lay people as being straightforwardly observable: Inner speech, visual images, feelings, and so on are understood to be directly apprehendable "before the footlights of consciousness." Many psychologists hold that such characteristics of inner experience play substantial theoretical roles and have applied significance across a wide range of cognitive, affective, performance, and clinical situations. If so, the frequency of occurrence of these characteristics is of fundamental importance. Such frequencies are usually estimated by questionnaires or by questionnaire-based experience sampling. However, there are reasons to wonder about the accuracy of such questionnaire-based estimates. We present three studies that compared, head-to-head, questionnaire-based experiential frequencies with frequencies discovered using descriptive experience sampling (DES), a method for random sampling in the natural environment that aspires to apprehend inner experience with as high fidelity as the state of the art allows. Together, they suggest that estimates of inner-experience frequency produced by questionnaires and DES are irreconcilably discrepant: Questionnaire-based methods produced dramatically higher (from 2 to 4 times as high) frequencies than did DES. These results suggest caution when interpreting questionnaire-based experiential results and the importance of additional high-fidelity studies of inner experience.

Keywords
inner experience, questionnaire, experience sampling, descriptive experience sampling, inner speech, self-talk

Most people (including most behavioral scientists) accept that inner experiences (inner speech, visual imagery, feelings, etc.) exist as naturally occurring, directly apprehendable phenomena. Lay references to such inner phenomena are ubiquitous, as when the TV reporter asks, "How did you feel when you . . . ?" or "What were you thinking when you . . . ?" Psychologists writing about inner speech typically begin with a sentence such as "Inner speech is the little voice in the head" (Langland-Hassan et al., 2015, p. 1), implying that such little voices are familiar phenomena. "No author ever denies the experiential aspects of [visual] imagery" (Runge et al., 2017), even though they might disagree about imagery information processing (Kosslyn, 1994). Experience-sampling probes such as "At the time of the beep, my mind had wandered" (Kane et al., 2007, p. 616) imply that participants have direct access to their mind wandering. Psychologists generally agree that emotion has an experiential "feeling" aspect (Rottenberg & Gross, 2003; Watson, 2000). Psychiatric diagnosis depends on accounts of distressing thoughts and feelings. In short, people are generally understood as having direct access to (at least some of) their inner phenomena.

There are, broadly speaking, two widely used methods to investigate the frequencies of inner phenomena: questionnaires and questionnaire-based experience sampling. Questionnaires about frequency typically present straightforward, face-valid queries such as, "How often do you experience an inner voice when you read?" (Moore & Schwitzgebel, 2018, p. 59). Such

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questions presume that the respondent not only has direct immediate access to the phenomenon of interest but also has retrospective knowledge about such phenomena and the skill to estimate their frequencies.

Because the problematics of such retrospection and frequency-estimation processes are well known, some investigators use experience-sampling methods, which reduce retrospection by beeping participants in their natural environments and presenting questionnaire-like items that inquire whether specified kinds of experience were ongoing (e.g., "In the final split second before the beep"; Moore & Schwitzgebel, 2018, p. 61) or recent (e.g., "Over the last *two hours*"; Brinthaupt et al., 2015, p. 5). Such questionnaire-based experience sampling eliminates the need for participants' frequency estimations: Investigators compute frequencies from the proportion of "yes" responses.

These methods have been validated by comparing questionnaire and experience-sampling results. For example, Moore and Schwitzgebel (2018) found the frequency of self-talk while reading averaged about 60% whether estimated by participants on retrospective self-report questionnaires ("How often do you . . . ?") or by tallying online questionnaire-based experience-sampling responses ("In the final split-second before the beep were you . . . ?").

Brinthaupt et al. (2015) investigated self-talk in a variety of situations both by questionnaire and questionnaire-based experience sampling. Using the Self-Talk Scale (STS; Brinthaupt et al., 2009) questionnaire, which uses Likert-scale frequency ratings from 1 (*never*) to 5 (*very often*) on items such as "I talk to myself when I feel ashamed of something I've done," they found that self-talk was reported as occurring in about 58% of situations. Likewise, when using experience sampling, they found that self-talk occurred in about 65% of situations: They delivered randomly timed text messages asking participants to respond "yes" or "no" to modified STS items about predefined situations (e.g., "Over the last *two hours*, I have been in a situation where I feel ashamed of something I've done"). If participants responded "yes" (that the situation had occurred), they were prompted to respond "yes" or "no" to "Did you talk to yourself (either silently or aloud) during or immediately after the situation occurred?" (Brinthaupt et al., 2015, p. 5).

Thus, despite their very different contexts (while reading or in specified situations) and very different experience-sampling methods (immediately after the event vs. over the past 2 hr), these studies produced very similar results: Whether by questionnaire or questionnaire-based experience sampling, self-talk occurred roughly two thirds of the time.

Such consistency might suggest that self-talk actually occurs roughly two thirds of the time across a wide variety of situations and that questionnaires and questionnaire-based experience sampling are adequate measures of that frequency. However, Hurlburt and Heavey (2006, 2015) claimed that people are often mistaken about the nature of their own inner experience and are therefore unlikely to answer accurately such questions as "How often do you . . . ?" Hurlburt and Heavey worried that people's characterizations of their inner experiences on questionnaires or questionnaire-based experience sampling may reflect situational demands and presuppositions about inner experience rather than their actual experienced phenomena. For example, participants who believe that self-talk is frequent or omnipresent would likely respond *very often* to the STS questionnaire items and *yes* to the modified-STS experience-sampling items regardless of whether self-talk actually occurs often or in the past 2 hr. This worry parallels Sherlock Holmes's idea that "insensibly [they would begin] to twist facts to suit theories, instead of theories to suit facts" (Doyle, 1900/2019, p. 3).

There are, broadly speaking, three strategies for dealing with this worry (Hurlburt & Heavey, 2001): accede to the worry and bar from science all reports of inner experience, overlook the worry and act as if people know their inner experience, or confront the worry head on by trying, in principled ways, to reduce the effect of situation and presuppositions and thus to obtain samples of inner experience apprehended with high fidelity. Hurlburt and his colleagues developed descriptive experience sampling (DES; Caracciolo & Hurlburt, 2016; Hurlburt, 1990, 1993, 2011; Hurlburt & Heavey, 2006) in that third spirit.

Unlike questionnaire-based experience sampling, DES uses an iterative-training, presupposition-bracketing interview method that aspires to obtain a high-fidelity description of each at-the-moment-of-the-beep experience. DES is described more fully in the Supplemental Material available online. For a case-study illustration of DES—how it works and why its results can be surprising—see Box S1 in the Supplemental Material. For an explanation of how DES is very different from eyewitness testimony because DES "witnesses" are iteratively trained and prepared rather than taken by surprise by a one-time occurrence, see Box S2 in the Supplemental Material. For information on how DES avoids the false memories of the kind discussed by Loftus (2005), because typical false memories are for distantly past rather than immediate events, see Box S3 in the Supplemental Material. For an explanation of how DES includes substantial channel-opening factors, thus avoiding the kinds of pressures on participants' reports discussed by Ross and Nisbett (1991) and others, see Box S4 in the Supplemental Material. For a discussion of memory and use of the DES notebook, see Box S5 in the Supplemental Material.

For a discussion of the aspirational goal of apprehending inner experience with fidelity, see Box S6 in the Supplemental Material. In brief, fidelity refers to "faithfulness to the original"; apprehending inner experiences with fidelity refers to the creation of deft and unbiased (to the extent possible) descriptions of experiences that actually transpired but could be directly apprehended only by the experiencers themselves. Setting aside for now the important question of the extent to which DES investigators actually achieve that goal, we note that DES requires substantially more effort and investigator skill than do either questionnaires or questionnaire-based experience-sampling methods (McKelvie, 2019). Furthermore, DES presents experiential science with far more difficulties (e.g., establishing the credibility of an investigator) than are present with questionnaire-based methods. Therefore, science should examine whether DES produces results that are substantially similar to questionnaire-based methods. If so, then science can rely on questionnaires and use the labor-intensive DES only rarely, perhaps only as a validating criterion for questionnaire-based measures. If the results are substantially discrepant, however, then behavioral science will have to sort out the differences among the methods and the conditions under which each is appropriate.

One pair of studies allows a rough comparison of questionnaire, questionnaire-based experience sampling, and DES. As mentioned above, Moore and Schwitzgebel (2018) found both by questionnaire and by questionnaire-based experience sampling that self-talk occurred about 60% of the time when people were reading. By contrast, using DES, Brouwers et al. (2018) found that self-talk occurs only about 3% of the time while reading. That huge discrepancy suggests that the difference between questionnaire-based methods and DES might be substantial. However, that interpretation is confounded by methodological differences (e.g., recruiting methods, reading material). Furthermore, reading is a specialized situation, so generalizing to everyday nonreading experience is questionable. It is therefore desirable to attempt a comparison of questionnaire-estimated frequency and DES-based frequency that limits these potential confounds.

Three Studies Comparing Questionnaires and DES

We present here three studies that directly compare questionnaires and DES; such head-to-head comparisons have never (to our knowledge) been attempted (for an explanation of why we did not also compare questionnaire-based experience sampling, see Box S7 in the Supplemental Material).

Our studies used two questionnaires, the STS and the Nevada Inner Experience Questionnaire (NIEQ; Heavey et al., 2019). We used the STS to allow replication of Brinthaupt et al. (2015). We used the NIEQ to generalize beyond self-talk and because it has three features that allow a direct comparison with DES frequencies: (a) The NIEQ measures the same five frequent phenomena (5FP; Kühn et al., 2014) that DES studies typically discover: inner speaking (i.e., inner speech), inner seeing (i.e., seeing images), unsymbolized thinking, feelings, and sensory awareness (for a description of these phenomena, see Box S8 in the Supplemental Material); (b) the NIEQ inquires directly about experiential frequencies, whereas other questionnaires conflate frequency and other variables (e.g., the STS inquires about self-talk in specific situations but does not measure the frequency of those situations); and (c) the NIEQ asks for frequency estimates by using visual-analogue scales with unambiguous anchors, such as from *never* to *always*, whereas other questionnaires use Likert-type scales with ambiguous anchors (e.g., the STS endpoint is *very often*).

In our three studies, we sought to answer the following question: To what extent are the frequencies of inner experience as measured by questionnaires similar to the natural-environment frequencies measured by the fidelity-aspiring DES method? For the method details for Studies 1, 2, and 3, see Boxes S9, S10, and S11, respectively, in the Supplemental Material. See Table 1 for a comparative overview of the three studies.

Study 1 is a conceptual replication of Brinthaupt et al.'s (2015) Study 2, which administered the STS questionnaire to a large screening group, selected participants whose STS scores were in either the upper or the lower quartile, and then engaged them in experience sampling using items modified from the STS. Brinthaupt and colleagues found, via experience sampling (and as predicted), that the high-STS group reported more self-talk (73%) than did the low-STS group (54%). Our replication differs from Brinthaupt et al.'s Study 2 in three ways. First, we considered not only self-talk but also the 5FP (inner speaking, inner seeing, unsymbolized thinking, feelings, and sensory awareness); we therefore used not only the STS but also the NIEQ. Second, we obtained frequency estimates from an unambiguous visual-analogue questionnaire (the NIEQ) instead of relying only on the ambiguous STS. Third, we used a fidelity-aspiring experience-sampling method (DES) instead of a questionnaire-based experience-sampling method (items modified from the STS).

In brief, each participant wore a beeper that delivered six random beeps in the participant's natural

Table 1. All Studies: Comparing the Methods

Element	Study 1	Study 2	Study 3
Method	Box S9 in the Supplemental Material	Box S10 in the Supplemental Material	Box S11 in the Supplemental Material
Rationale	Conceptual replication of Brinthaupt et al.'s (2015) STS validity study, except we used DES and Brinthaupt et al. used questionnaire-based experience sampling	Replication of Study 1 except without stratification	Replication of Study 2 except in a clinical sample (to extend generalizability) and no specific focus on self-talk
Analysis	Between methods (questionnaire vs. DES; within subjects); also between groups (high-STS subjects vs. low-STS subjects)	Between methods (questionnaire vs. DES; within subjects)	Between methods (questionnaire vs. DES; within subjects)
Screening population	$N = 260$, subject-pool volunteers who took the STS and NIEQ	$N = 60$, subject-pool volunteers who took the STS and NIEQ	$N = 43$, community mental-health center prospective clients (no screening questionnaires)
Sampling participants	$N = 16$, stratified into two groups. The high-STS group ($N = 10$) was a random sample from the STS upper quartile (STS score > 66; mean STS percentage[a] = 86.6%). The low-STS group ($N = 6$) was a random sample from the STS lower quartile (STS score < 52; mean STS percentage = 40.6%).	$N = 12$, randomly chosen, no stratification	$N = 13$, volunteers
Questionnaires administered	STS and NIEQ	STS and NIEQ	NIEQ
Sampling method	DES in the natural environment	DES in the natural environment	DES in the natural environment
Coding method	Both phenomenological and inclusive	Phenomenological	Phenomenological
Sampling days	4	5	4 to 8
Number of samples[b]	270	270	456
Samples per participant[c]	16.88	22.50	35.08

Note: STS = Self-Talk Scale (Brinthaupt et al., 2009); DES = descriptive experience sampling; NIEQ = Nevada Inner Experience Questionnaire (Heavey et al., 2019).
[a]STS percentages were derived from STS total score following Brinthaupt et al. (2015, p. 6): STS percentage = 100 × (STS total – 16)/64. [b]These values exclude the first day as training. [c]These mean values exclude the first day.

environment. Within 24 hr, at least two investigators conducted an "expositional interview" with the participant; the interview asked, "What, if anything, was in your experience at the moment of the beep?" followed by clarifying and disambiguating questions designed to bracket presuppositions and iteratively improve the participant's skills. Then within 24 hr of the interview, the interviewers wrote a "contemporaneous description" of each sampled experience. This process of natural environment sampling followed by interview was repeated three additional times.

Because of the increase in bracketing-presupposition and attending-to-experience skills fostered in the first expositional interview, the participant's second-day sampling was likely to be more skillful than was the first-day sampling, the second-day expositional interview was likely to be more focused than was the first-day interview, and so on, iteratively, across subsequent days (Hurlburt, 2009).

After an individual completed the 4 days of sampling, the investigators met to review all of that individual's samples and briefly characterize the phenomena present

Table 2. All Studies: Spearman-Brown-Corrected (Split-Half) DES Reliabilities

Variable	Study 1[a] ($N = 16$)	Study 2[b] ($N = 12$)	Study 3[c] ($N = 13$)	Mean
Self-talk	.94	—	—	
5FP				
Inner speaking	.92	.97	.96	.95
Inner seeing	.73	.81	.98	.83
Unsymbolized thinking	.35	.82	.88	.65
Feeling	.83	.72	.59	.72
Sensory awareness	.82	.94	.86	.87

Note: All means are weighted by degrees of freedom. Self-talk was measured only in Study 1. DES = descriptive experience sampling; 5FP = five frequent phenomena (Kühn et al., 2014).
[a]Mean samples per participant = 16.88. See the main diagonal of Table S1 in the Supplemental Material. [b]Mean samples per participant = 22.50. See the main diagonal of Table S2 in the Supplemental Material. [c]Mean samples per participant = 35.08. See the main diagonal of Table S3 in the Supplemental Material.

for each sampled experience. Then, each sampled experience was independently coded for the presence (1), absence (0), or partial or possible presence (0.5) of self-talk and each of the 5FP by three investigators who had participated in the interviews. For a more complete description of the coding procedure, see Box S9b in the Supplemental Material. Inner speaking was coded in two ways: phenomenological and inclusive. In general, speaking includes the (a) experience of words, (b) the experience of a voice, and (c) the experience of producing the speaking. Phenomenologically, speaking is distinguished from, for example, hearing: One's own voice is experienced as *speaking* when talking into a tape recorder and as *being heard* when the same utterance is played back. DES typically defines inner speaking in that same way (e.g., Hurlburt et al., 2013), so we coded *phenomenological* inner speaking in a way that excludes inner hearing. However, many researchers consider inner speech to be heard, so we also coded *inclusive* inner speaking in a way designed to cast as wide a net for inner speech as is reasonable, including any instance in which the participant's own words were innerly present regardless of whether those words were innerly spoken, innerly heard, or innerly present without being spoken or heard.

Brinthaupt et al. (2009) defined self-talk as including either aloud self-talk or inner speaking. Therefore, we coded aloud self-talk and calculated (total) self-talk as occurring if an experience included either aloud self-talk or inner speaking (or both).

Thus, three investigators independently coded each sample for seven phenomena: inner speaking (phenomenological), inner speaking (inclusive), inner seeing, unsymbolized thinking, sensory awareness, feelings, and aloud self-talk.

Study 2 replicated the methods of Study 1 except there was no stratification, thus ruling out the possibility that the Study 1 participant selection strategy (sampling from the extremes) might have had unintended effects on some inner-experience characteristics. Study 2 also eliminated the focus on self-talk because Study 1 had shown very similar results for self-talk and the 5FP's inner speaking; likewise, Study 2 eliminated the inclusive coding because the Study 1 inclusive coding showed the same pattern of results as did the phenomenological coding.

Study 3 replicated the methods of Study 2 except with a clinical sample (i.e., subjects who were not part of the subject pool), thus extending the study's generalizability. Studies 2 and 3 are parts of larger unpublished studies (see Box S12 in the Supplemental Material).

Reliability of DES

The three ways that we evaluated the adequacy of our DES implementation in Study 1 are described in Box S13 in the Supplemental Material. In brief, each of three independent coders provided 1,890 codings (7 codings for each of 270 samples); they unanimously agreed on 1,782 of them (94%). Then, for each participant, we computed the self-talk and the 5FP DES mean ratings separately for the odd-numbered and even-numbered samples. The first column of Table 2 shows the split-half-derived Spearman-Brown-corrected reliabilities of these DES measurements. The Study 1 intercorrelations between DES 5FP measurements were relatively small (see Table S1 in the Supplemental Material). Table 2 (and Tables S2 and S3 in the Supplemental Material) also shows parallel results for Studies 2 and 3.

Table 3. Study 1: Comparing Questionnaire Percentages and DES Sampling Percentages for All DES Participants

Variable	Questionnaire[a]	DES sampling[b]	Questionnaire – DES	$t(15)$[c]	p	d
		Self-talk				
Total	69.3[d] (24.4)					
Inclusive		25.0 (19.02)	44.3[e] (27.8)	6.38	< .001	1.60
Phenomenological		17.9 (16.7)	51.4[e] (26.7)	7.72	< .001	1.93
Aloud		3.0 (6.7)	[f]			
		5FP				
Inner speaking	66.6[gh] (25.6)					
Inclusive		22.0 (17.0)	44.6[i] (29.6)	6.03	< .001	1.51
Phenomenological		15.0 (15.5)	51.6[i] (29.1)	7.09	< .001	1.77
Inner seeing	69.0[g] (27.2)	20.1 (16.2)	48.9[i] (27.4)	7.13	< .001	1.78
Unsymbolized thinking	38.8[g] (25.3)	11.8 (10.8)	27.0[i] (26.8)	4.03	.001	1.01
Feeling	79.1[g] (20.0)	17.8 (16.9)	61.3[i] (26.2)	9.35	< .001	2.34
Sensory awareness	68.5[g] (18.7)	33.0 (19.3)	35.6[i] (27.9)	5.11	< .001	1.28

Note: The first three columns present unweighted mean frequencies across participants, with standard deviations in parentheses. DES = descriptive experience sampling; 5FP = five frequent phenomena (Kühn et al., 2014); Self-Talk Scale (Brinthaupt et al., 2009); NIEQ = Nevada Inner Experience Questionnaire (Heavey et al., 2019).
[a]These values are percentages from the "DES participants All (N = 16)" column of Table S4 in the Supplemental Material. [b]The values in this column are from the "All (N = 16)" column of Table S5 in the Supplemental Material. [c]The t-test results here are from a comparison of questionnaire percentage and DES percentage, dependent samples. [d]Self-talk was measured by the STS, which does not distinguish between inclusive and phenomenal self-talk or between silent or aloud self-talk. [e]These values were calculated as STS percentage minus DES percentage. [f]There were too few instances to be meaningful. [g]These values are NIEQ percentages from the "DES Participants All (N = 16)" column of Table S4 in the Supplemental Material. [h]The NIEQ does not distinguish between inclusive and phenomenological inner speaking. [i]These values were calculated as NIEQ subscale percentage minus DES percentage.

These reliabilities are very high for self-talk and inner speaking and acceptable for the other coded phenomena. The off-diagonal correlations are small in Tables S1, S2, and S3 in the Supplemental Material, as is desirable. The conclusion is that whatever DES measures, it does so reliably.

Comparing questionnaires and DES

There are two main features of Study 1's replication of Brinthaupt et al. (2015): the between-methods comparison (questionnaire vs. DES) and the between-groups comparison (high STS vs. low STS). Because our primary focus here is on between-methods comparisons, we describe the between-groups results in Box S14 in the Supplemental Material. In brief, our Study 1 found, unlike Brinthaupt et al. (2015), no statistically significant difference in DES-discovered self-talk between our high-STS and low-STS groups regardless of whether self-talk was coded phenomenologically or inclusively.

The between-methods (questionnaire vs. DES) comparison for the 16 DES participants of our Study 1 is shown in Table 3. The first column shows the questionnaire descriptive statistics; its first entry shows the STS percentage (replicating Brinthaupt et al., 2015), and the remaining entries show the NIEQ percentages. Note that the STS estimate of self-talk (69.3%) is very similar to the NIEQ estimate of inner speech (66.6%) even though these two questionnaires are very different—the STS uses Likert scales with ambiguous anchors, whereas the NIEQ uses visual-analogue scales with unambiguous anchors. That is, the two questionnaires operated as expected (see also the discussion of Table S4 in Box S14 in the Supplemental Material).

The second column of Table 3 shows the Study 1 DES descriptive statistics (see also the discussion of Table S5 in Box S14 in the Supplemental Material). Table 3's top section shows the DES self-talk percentages (conceptually replicating Brinthaupt et al., 2015), coded either inclusively, phenomenologically, or aloud; its bottom section shows the DES-measured 5FP percentages. Note that aloud self-talk is rare (occurring in 3% of samples; for examples, see Box S9b in the Supplemental Material), so total self-talk frequency and inner speaking frequency are very similar.

The third column of Table 3 shows the difference between the questionnaire percentage and the DES percentage (subtracting the DES sampling values from the questionnaire values). For example, before sampling, our DES participants self-reported (on the STS) that self-talk occurred on average in 69.3% of a range of situations, whereas according to DES, their self-talk (even coded inclusively) occurred on average only 25.0% of the time. That difference (69.3% – 25.0% = 44.3%) is

Table 4. Corresponding NIEQ and DES Results From Study 1 ($N = 16$), Study 2 ($N = 12$), and Study 3 ($N = 13$)

	NIEQ subscale frequency percentages				DES frequency percentages				NIEQ – DES frequency percentages			
Variable	Study 1[a]	Study 2[b]	Study 3[c]	Mean	Study 1[d]	Study 2[e]	Study 3[f]	Mean	Study 1[g]	Study 2[h]	Study 3[i]	Mean
Inner speaking	66.6	64.4	75.6	68.8	15.0[j]	12.3	14.6	14.1	51.6	52.1	61.0	54.7
Inner seeing	69.0	56.0	55.5	61.0	20.1	17.6	18.7	19.0	48.9	38.5	36.8	42.1
Unsymbolized thinking	38.8	28.9	39.5	36.2	11.8	10.2	15.6	12.5	27.0	18.7	23.9	23.6
Feeling	79.1	70.8	75.4	75.5	17.8	11.8	12.1	14.3	61.3	59.0	63.3	61.3
Sensory awareness	68.5	58.4	59.7	62.8	33.0	30.3	27.3	30.4	35.6	28.1	32.4	32.4

Note: All means are weighted by degrees of freedom. STS = Self-Talk Scale (Brinthaupt et al., 2009); DES = descriptive experience sampling; NIEQ = Nevada Inner Experience Questionnaire (Heavey et al., 2019).
[a]See Table 3, "Questionnaire" column. [b]See Table S8 in the Supplemental Material, "NIEQ Questionnaire" column. [c]See Table S9 in the Supplemental Material, "NIEQ Questionnaire" column. [d]See Table 3, "DES sampling" column. [e]See Table S8 in the Supplemental Material, "DES Sampling" column. [f]See Table S9 in the Supplemental Material, "DES Sampling" column. [g]See Table 3, "Questionnaire – DES" column. [h]See Table S8 in the Supplemental Material, "NIEQ – DES" column. [i]See Table S9 in the Supplemental Material, "NIEQ – DES" column. [j]This displays the phenomenologically coded value so as to be comparable with the codings in Studies 2 and 3.

statistically significant with a huge effect size—paired-samples $t(15) = 6.38$, $p < .001$, $d = 1.60$. Note that the STS measures self-talk in specific situations, whereas DES measures self-talk in the natural environment (for a discussion of whether that is a reasonable comparison, see Box S16 in the Supplemental Material).

The bottom of Table 3 extends beyond self-talk by comparing the NIEQ questionnaire-estimated 5FP frequencies with their DES-sampling-frequency counterparts. Note that for each individual 5FP phenomenon, the NIEQ estimates were at least twice and more often 3 or 4 times higher than the corresponding DES frequencies even though both putatively measured the same thing. Across all the 5FP, the average NIEQ – DES discrepancy was 45.1%. All these differences were statistically significant ($p \leq .001$) with large effect sizes (smallest $d = 1.01$; mean $d = 1.64$). Note particularly that the STS self-talk and NIEQ inner-speaking results are similar (for a comparison of the DES results with those of Heavey & Hurlburt, 2008, see Box S17 in the Supplemental Material).

Studies 2 and 3 replicated the between-methods comparisons of Study 1 (see Box S15 in the Supplemental Material). Table 4 summarizes the main between-methods results across all three studies. The left section shows the NIEQ-questionnaire-measured frequency means for all sampling-phase participants. For example, the mean frequency of NIEQ-questionnaire-measured inner speaking ranged from 64.4% (for the 12 participants of Study 2) to 75.6% (for the 13 participants of Study 3). Note that these NIEQ inner-speaking-frequency estimates are very similar across the three studies; that is also true for the remaining sets of NIEQ subscale means.

The middle section of Table 4 presents the DES-sampling-measured frequency means across all three studies. For example, the mean frequency DES-sampling-measured inner speaking ranged from 12.3% to 15.0%. Note that these DES inner-speaking-frequency estimates are very similar across the three studies; that is also true for the remaining sets of DES 5FP means.

The right section of Table 4 presents the NIEQ – DES frequency differences across the three studies, subtracting the middle-panel results from the corresponding left-panel results. For example, the mean NIEQ – DES frequency difference for inner speaking ranged from 51.6% to 61.0%. Note that the NIEQ – DES frequency differences for inner speaking are very similar across the three studies, and those differences are huge. That is also true for the remaining sets of NIEQ – DES percentage differences.

In addition to considering the differences between NIEQ and DES frequencies, we also considered the correlations between those measures. Those correlations were close to zero, but because the sample sizes were small, we report them only in Box S18 in the Supplemental Material.

Figure 1 graphs the self-talk results across our three studies. Figure 1 also shows, for comparison, the self-talk results of the "while-reading" studies of Moore and Schwitzgebel (2018) and Brouwers et al. (2018) as well as Brinthaupt et al.'s (2015) 16-situation results (combining Brinthaupt et al.'s high- and low-STS groups). Note that that the results for the questionnaires (all the dotted bars) are very similar. In particular, the results for the NIEQ ISpeaking questionnaire are very similar to each other and to those of the other questionnaires. In addition, results for questionnaire-based sampling (black diagonal stripes) are very similar to those of the questionnaires—much more similar to the

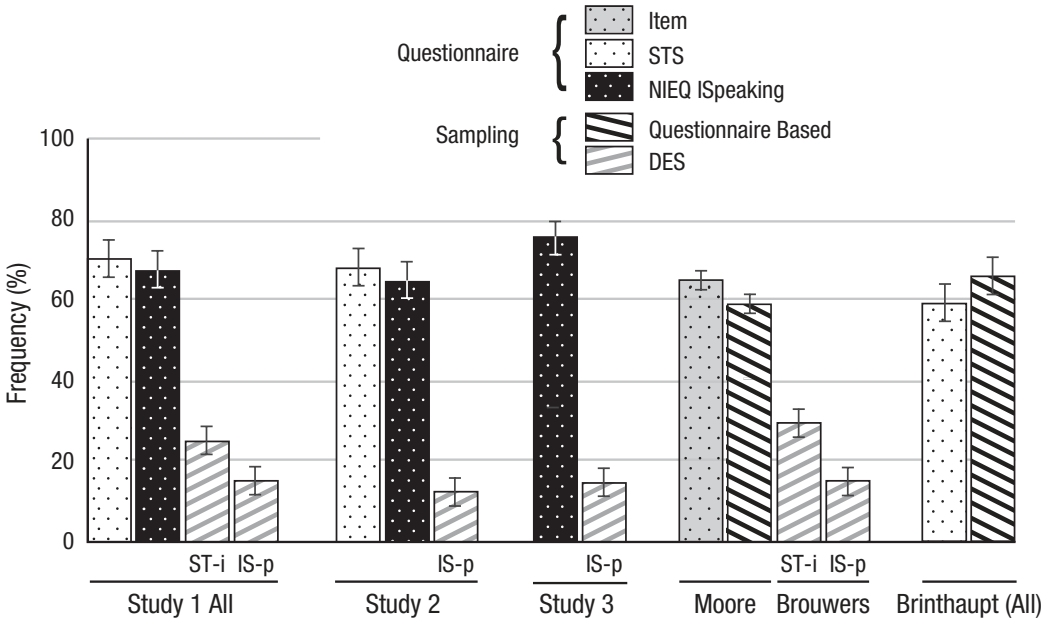

Fig. 1. Results from all studies: comparing self-talk by questionnaire and experience sampling. STS = Self-Talk Questionnaire (Brinthaupt et al., 2009); NIEQ = Nevada Inner Experience Questionnaire (Heavey et al., 2019); ST-i = self-talk (inclusively coded); IS-p = inner speaking (phenomenologically coded). Error bars indicate ±1 *SE*. In the key, "Item" = Moore and Schwitzgebel's (2018) online questionnaire item regarding inner speech. "Moore" = Moore and Schwitzgebel's (2018) Study 2 of experience while reading (for comparison). "Brouwers" = results from Brouwers et al. (2018) study of experience while reading (for comparison). Note that Brouwers et al. referred to ST-i as "words of any kind," and they referred to IS-p as "inner speaking" (although they included inner hearing). "Brinthaupt (All)" = results from Brinthaupt et al. (2015) Study 2, combining all participants (for comparison).

questionnaires than to the DES experience sampling (gray diagonal stripes). Finally, the results for DES sampling (regardless of whether the DES coding is inclusive or phenomenological) are very similar to each other but dramatically smaller than for any questionnaire-based method.

In short, all self-talk frequencies based on questionnaires, whether retrospective questionnaires (Moore and Schwitzgebel's item, the STS, or NIEQ ISpeaking) or questionnaire-based experience sampling (Moore & Schwitzgebel, 2018, or Brinthaupt et al., 2015), are approximately equal and high (roughly two thirds of the time). The self-talk frequencies based on DES (whether coded inclusively or phenomenologically) are approximately equal and much smaller (roughly one sixth of the time).

The self-talk frequency distributions between questionnaire and DES have relatively little overlap (see Box S19 in the Supplemental Material, which zooms in on a portion of Fig. 1).

Figure 2 extends beyond self-talk to the 5FP by comparing the NIEQ questionnaire and the DES sampling results. Note that for each of the 5FP phenomena, the NIEQ-questionnaire estimates are very consistent across studies, as are the DES-sampling results. Note also that for each of the 5FP phenomena, the DES results are dramatically smaller than are the NIEQ estimates.

How can results be so discrepant?

Despite the fact that the NIEQ (by questionnaire) and DES (by sampling) intend to measure the same thing (the 5FP frequencies in the natural environment), the NIEQ and DES apparently measure very different things: The questionnaire provided hugely higher estimates than the sampling frequencies. These results are striking and consistent.

The discussion in Box S20 in the Supplemental Material suggests that the relatively small sample sizes of these studies are not grounds for dismissing them, so we ask whether science should understand these studies' huge discrepancies to be (a) merely a difference in the point of view between questionnaires and DES (as when fractal analysis shows different coastline lengths depending on the length of the measuring instrument); (b) an overestimation of the frequency of actual phenomena by questionnaires; (c) an underestimation of actual frequencies by DES; or (d) some combination of the above. The results of these studies do not lead to a definitive choice among those options, but they do

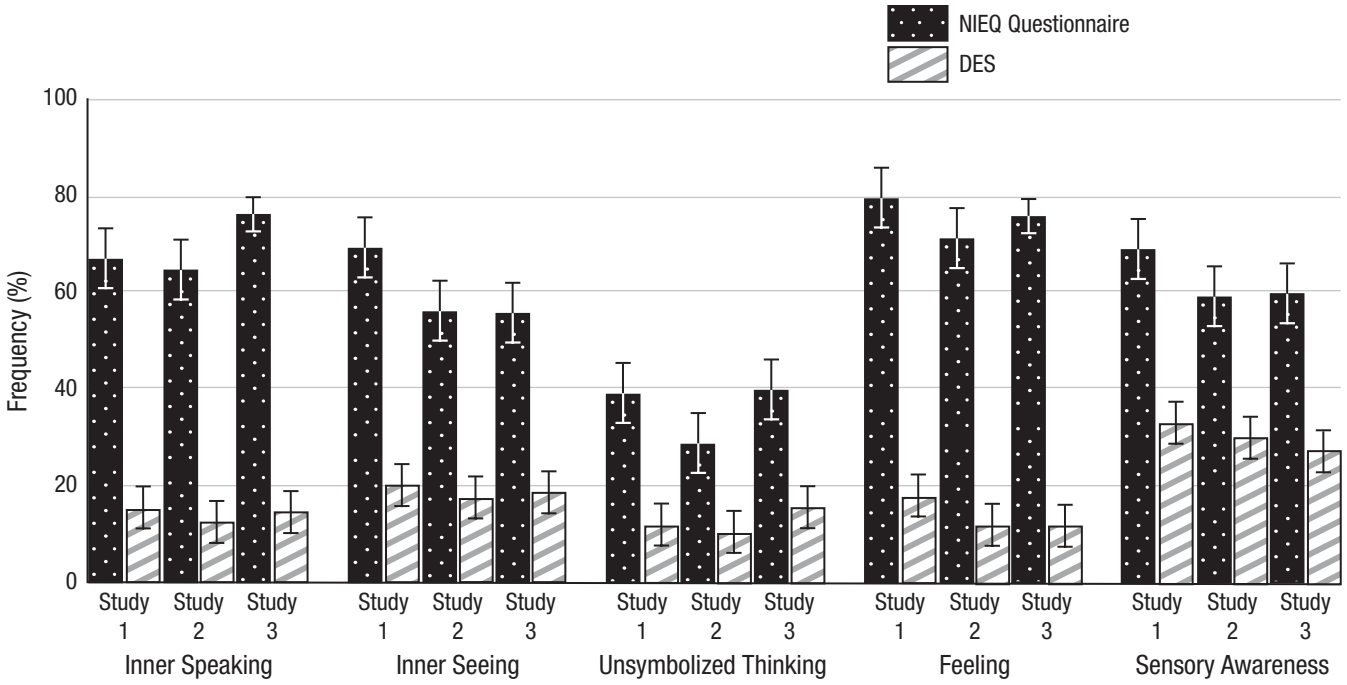

Fig. 2. Results from all studies: comparing the five frequent phenomena (5FP) by Nevada Inner Experience Questionnaire (NIEQ; Heavey et al., 2019) and descriptive experience sampling (DES). Error bars indicate ±1 *SE*. Inner speaking results are redisplayed from Figure 1.

suggest that psychological science might profit from a series of studies by a variety of investigators, all trying to tease these and other options apart.

Without being dogmatic, we favor the second idea, that questionnaires likely overestimate the frequencies of inner experiential phenomena. That perspective comes not only from these three studies but also from many careful observations of DES participants (e.g., Steven in Box S1 in the Supplemental Material) who themselves came to realize that they had been ignorant about their own inner experience. For example, Hurlburt and Krumm (2020) publicly used DES with Ryan, the protagonist in the recent everyone-has-constant-internal-monologue Internet kerfuffle (Soloducha, 2020), and found few examples of the internal monologue that Ryan had thought were ubiquitous.

One might wonder how people can be mistaken about their own experience. We offer six speculations. First, people have no comparison group on which to hone the skills required to apprehend, discriminate, and describe phenomena. The totality of one's experienced phenomena come from a single source—oneself. Second, most people find their own DES-discovered inner experience mundane and boring (by their own standards). Faithfully apprehending and describing one's inner experience does not seem interesting. Third, there may be evolutionary or cultural pressure favoring suppressing candid expression of inner experience (think about a king's response to people who reveal that they find the queen attractive). Fourth, inner-experience characteristics are almost always importantly just outside of view. One is generally interested in whatever one is interested in, not in the manner in which one experiences it. Fifth, armchair introspection (asking oneself, "What's going on with me right now?") is doubly fraught (Hurlburt & Schwitzgebel, 2011): One chooses to introspect only on certain occasions (exactly those in which it occurs to one to introspect), and asking the question substantially disturbs the experience meant to be introspected. The beep's randomness alleviates the special-occasion problem, and its fast rise time might substantially lessen the disturbance, but of course that is open to scientific evaluation. Sixth, people confuse self-theories, folk theories, generalities, and/or plausibility notions with experience itself. On a questionnaire or at a questionnaire-based beep, one might endorse inner speech because it seems reasonable, not because one directly apprehends it. We note that the characteristics of one's experience might be important even if one is mistaken about those characteristics.

Implications

In a narrow sense, we have examined the contrast between one fidelity-aspiring method (DES) and questionnaire-based measures of experiential frequencies. In a broader sense, in this article, we suggest the potential importance of high-fidelity explorations of

everyday inner experience. Investigations that seek to characterize everyday inner experience are rare. For example, whereas introductory psychology textbooks frequently include chapters on "consciousness," those chapters focus predominantly on dreaming, drugs, and selective attention. Only rarely do they even mention the characteristics of everyday waking experience. Psychological science has not invested in high-fidelity investigations of experience.

Experience-sampling studies typically include instructions such as "Please refer to the thought occurring right before the alarm sounds" (Bryant et al., 2013, p. 705). Those instructions seem simple and unambiguously straightforward, but DES has shown that DES participants on the first sampling day respond to such instructions in hugely discrepant ways. For example, DES participants (as subsequent interviewing shows) use "thought" to refer to vastly different phenomena ranging from feelings to sensory awarenesses to (as might have been expected) cognitive events (Hurlburt & Schwitzgebel, 2007, p. 61). Furthermore, despite being instructed to focus on experience "right before the beep sounds," on the first sampling day, DES participants sometimes describe experiences that actually occurred hours or days before the beep, during the beep, or after the beep or that were not experienced at all (Hurlburt, 2011). We believe that questionnaire-based experience-sampling participants have similarly discrepant ways of understanding seemingly unambiguous instructions but that those discrepancies remain hidden in questionnaire-based research. We conclude that substantial (probably iterative) training is required to disambiguate everyday terminology and instructions; such training is rare or nonexistent in questionnaire-based experience sampling (Hurlburt & Heavey, 2015). Furthermore, if questionnaire users provide any training that goes beyond the validation sample, their questionnaire administration would be considered invalid.

There are studies that investigate directly apprehended experiential aspects other than frequency. For example, Fazekas et al. (2020) considered the neural correlates of vividness of visual imagery, which was typically measured with the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973) and/or the Perceptual Awareness Scale (PAS; Ramsøy & Overgaard, 2004). Visual-imagery vividness was said to have three characteristics: (a) The maximum visual-imagery vividness is "as clear and as vivid as normal vision" (as the VVIQ puts it); (b) if imagery is not clear or vivid, it is "degraded" or "reduced in quality" (Fazekas et al., 2020, p. 1202); and (c) vividness is a characteristic of the entire conscious experience (as it must be to inquire about its neural correlates). However, our DES studies suggest that none of those characteristics are necessary. Regarding (a), Hurlburt (1990) described instances in which patients with schizophrenia had imagery that was more clear and vivid than normal vision. This phenomenon is not limited to people with schizophrenia; Raymond (2011) also reported it in veterans with posttraumatic stress disorder. Regarding (b) and (c), here is an example from Hurlburt and Schwitzgebel (2007):

> Susan, a college student, was critical of her roommate Helen's relationships with boys. Susan had an image of Helen, seen from the waist up sitting on their couch with a boy. Helen in the image was wearing only a bra. Helen and the couch and the bra were seen clearly in this image, but the boy's face was unelaborated or indistinct. . . . [Susan's] indeterminate boy was not merely the result of weak imagery but was a highly skilled construction of indeterminacy precisely where she meant indeterminately to represent *lots* of boys. (p. 106)

Susan's lack of clarity was (or at least might have been) an intentional blurring that was highly skillful, not degraded or reduced in quality. Moreover, the blurring applied to only a portion of the imagery, not the entire conscious experience.

Our studies suggest that skilled distortions such as Susan's blurring are not unique to Susan. Whether such distortions are important to the scientific study of vividness remains to be seen; here we note that questionnaires such as the VVIQ or PAS can never investigate such characteristics. To do so requires an aim at fidelity, which is not the case for questionnaire-based data (see Box S6 in the Supplemental Material).

A second example concerns mind wandering, which "is rooted in competition between self-relevant, internal priorities and task-relevant, external priorities" (Murray et al., 2020, p. 575). Following William James's (1890) statement that "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of *one* [emphasis added] out of what seem several simultaneously possible objects or trains of thought" (pp. 403–404), mind-wandering researchers typically presume that consciousness is (a) unitary and (b) composed of either externally driven trains of thought (i.e., perceptual experience) or internally driven trains of thought (experiences generated by the autobiographical memory system). However, Fernyhough et al. (2018) used DES to show that experience could be multiple, not (a) unitary, and could be simultaneously internal and external, not only (b) one or the other. Here is an example from a participant in that study:

> Jane was focused on the geometry of the scanner above her head, particularly on the distance between the mirror and the ceiling of the scanner (an external focus). Simultaneously she innerly saw the office where the DES interviews had taken place, as if she had been walking into the room. She saw the table and RH, the people behind him, the computer, and so on. This imaginary seeing is an internal focus. (Fernyhough et al., 2018, p. 8)

The mind-wandering literature does not discuss such samples because, as Murray and colleagues (2020, p. 582) summarized, mind-wandering studies typically interrupt participants and prompt them with some variant of "At the time of the beep, my mind had wandered to something other than what I was doing." That prompt presumes that the mind is (a) unitary and (b) either focused externally on the task or internally on something else.

Much of the energy in modern psychological science involves neuroscientific (e.g., functional MRI [fMRI]) studies that seek to identify brain-region correlates of cognitive events. Substantial resources are being expended to improve brain-region measurements, but the cognitive events are still typically measured by questionnaire (e.g., Delamillieure et al., 2010) or performance on cognitive tasks (e.g., Christoff et al., 2009), techniques that have not changed much since the invention of fMRI. However, Hurlburt et al. (2016), in an fMRI study, compared inner speech as elicited by the experimenter (e.g., "Say 'pencil'") with inner speech spontaneously occurring in the scanner (as identified by DES) and found that experimenter-elicited and spontaneous inner speech had different brain-region footprints. This small study clearly needs replication, but it suggests that neural correlates of consciousness science might profit from improving measurements of experience as well as brain activity.

Many questionnaires (unlike those we have been considering) measure personality traits or other inferred constructs, not directly apprehended experience. Our results do not apply directly to such questionnaires. For example, the NEO-Personality Inventory–3 (McCrae et al., 2005) measures traits such as conscientiousness and extraversion by presenting general self-characterization items such as "I'm not a very orderly or methodical person," which has no relationship or only a minor relationship to directly apprehended experience. We do not take a position on how our results might extrapolate to such questionnaires.

The bottom line, as we see it, is that scientists and practitioners should not assume that people adequately characterize their inner experience on questionnaires or in questionnaire-based experience-sampling methods. The studies presented or reviewed here show dramatic differences between questionnaire-based characterizations (done via retrospection or nonretrospectively via experience sampling) and fidelity-aspiring ones (done via DES). If we are to have a mature science of inner experience, the field must grapple with these findings. Perhaps replication attempts will reveal limitations of these studies. Perhaps science can advance fidelity-aspiring methods superior to or more efficient than DES. Perhaps science will find a way to create questionnaires that capitalize on the issues raised here—for example, perhaps a few days of DES iterative training can be followed by several days of questionnaire-based experience sampling. Perhaps if psychological science came to distinguish between high-fidelity explorations and self-characterizations, that distinction would percolate through to the lay community, the general societal appreciation for apprehending inner experience would increase, and the ability to respond to questionnaire-based probes would improve. Perhaps psychological science will recognize that whereas high-fidelity explorations are required for the exploration of absolute frequencies, the exploration of relative frequencies, personality traits, or other constructs may not have such requirements. Perhaps psychological science will decide that it is important to devote substantially more of its resources to high-fidelity explorations of inner experience. Much work remains.

Transparency

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Supplemental Material

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